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现任专业技术职务	讲师		现任专业技术职务批准时间		2007 年 07 月	
申报学科（一级/二级学科名称）		生物医学工程		研究方向	生物材料	
申报类别	■教师 □科学研究 □工程 □实验 □其他					

主要学习工作简历及海外经历（从高中起，应连续）

起止年月		学习与工作单位	学历、学位、专业、职务
起	止		
1994.09	1997.06	河北省晋州市第一中学	高中、学生
1997.09	2001.06	河北理工学院	本科、学士、测量工程、学生
2001.09	2004.06	南华大学	研究生、硕士、核技术及应用
2004.09	2007.06	中国科学院高能物理研究所	研究生、博士、粒子物理与原子核物理
2007.07	2009.10	北京航空航天大学	博士后
2009.11	至今	北京航空航天大学	生物医学工程、讲师
2015.01	2016.01	加拿大英属哥伦比亚大学	生物材料、访问学者（365 天）

研究水平和特点概述（限填 200 字）	从事纳米材料的生物相容性和传统医用钛材的表面改性研究。研究了纳米磨损颗粒在生物体内的转运，纳米颗粒对周围组织、细胞的病理学和生理学功能影响。研究了医用钛表面改性的阳极氧化条件优化，并制备生物活性涂层。获第 43 批中国博士后科学基金二等资助，获国家自然科学基金青年、面上各一项，以第一作者发表 SCI 收录论文 9 篇，EI 论文 1 篇，参与撰写中文专著 1 部，英文百科全书系列 2 部；获授权国家发明专利 1 项。

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学术论文题目	发表刊物或会议	发表（出版）时间	收录、他引情况	影响因子	期刊分区及排名/总数	作者排名
Anodization of highly ordered TiO_2 nanotube arrays using orthogonal design and its wettability	International Journal Electrochemical Science	2016. 01	SCI: DF1HC	1.5	Q3, 21/28 (电化学)	第一作者
Lung injury induced by TiO_2 nanoparticles depends on their structural features: Size, shape, crystal phases, and surface coating	International Journal of Molecular Science	2014.12	SCI:AX2TM 他引 9 次	2.862	Q2, 46/157 (化学)	第一作者
Effect of anatase TiO_2 nanoparticles on the growth of RSC-364 rat synovial cell	Journal of Nanoscience and Nanotechnology	2013.06	SCI: 161PI 他引 9 次	1.556	Q2, 74/157 (化学)	第一作者
Evaluation on cartilage morphology after intraarticular injection of titanium dioxide nanoparticles in rats	Journal of Nanomaterials	2012.09	SCI: 924MK 他引 2 次	1.644	Q2, 122/260 (材料科学)	第一作者
TiO_2 Nanoparticles translocation and potential toxicological effect in rats after intraarticular injection	Biomaterials	2009.09	SCI: 488DX 他引 44 次	8.557	Q1, 1/33 (材料科学)	第一作者

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一、符合职称申报条件论文	11(+1)	8(+1)			1		2	
其中：1.第一作者	11(+1)	8(+1)			1		2	
2.学生第一本人第二作者								
3.通讯作者								
二、其他	10	5			1		4	

任现职以来获得国家级教学/科研成果奖_____项；省部级教学/科研成果一等奖前五名、二等奖前三名或三等奖第一名__1__项。请填写任现职以来获得教学、科研、管理奖励情况（限填 3 项，代表作成果除外）

获奖项目	奖励名称	颁奖部门	奖励级别	获奖时间	人数	排名
校蓝天新秀项目	“蓝天新秀”称号	北京航空航天大学	校级	2009	1	1

任现职以来共获得排名第一（含学生第一本人第二）授权专利__1__项，其中发明专利__1__项，实用新型_____项，外观设计_____项。请填写任现职以来共获得已授权专利情况（限填 3 项）

专利名称	专利类型	授权日期	批准机构	专利号	权利单位	人数	排名
原位测试定位可控力学加载固定装置	国家发明专利	2013.09	国家知识产权局	ZL201110320495.2	北航	5	1

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项目名称	项目来源	起止时间	到款/经费总额
纳米 TiO_2 的结构特征影响骨形成能力的研究	国家自然科学基金(面上)	2013.01-2016.12	80/80 万
膝关节腔注射二氧化钛纳米颗粒的生物安全性研究	国家自然科学基金（青年）	2009.01-2011.12	20/20 万
第 43 批中国博士后科学基金	中国博士后科学基金会	2008.11-2009.10	3/3 万
纳米 TiO_2 的结构特征影响骨形成能力的研究	教育部	2012.10-2012.12	14.92/14.92 万
介入式主动脉瓣的研发	教育部	2012.03-2012.12	4/4 万

任现职以来其他项目情况（限填 3 项）

项目名称	项目来源	起止时间	负责人	承担份额/总额	主持/参与

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课程名称	起止时间	课程学时	本人授课学时	授课次数	授课对象	课程性质
生物统计学	2011.09-至今	32	16	5 次	本科生	必修
实验动物学	2011.09-2014.12	32	8	4 次	本科生	必修
食品药品与医疗器械的安全性评价	2012.03-2014.07	24	18	3 次	本科生	选修

主要学术兼职（限填 3 项）

学术兼职名称	受聘日期	颁授机构
无		

任现职以来其他业绩成果（限 100 字）	主持校级一般教改项目一项

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Anodization of Highly Ordered TiO_2 Nanotube Arrays Using Orthogonal Design and Its Wettability

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Using orthogonal design of experiments (DOE), the highly ordered TiO_2 nanotube arrays on Ti6Al4V alloy was achieved by anodic oxidation in a standard two-electrode system. According to the $L_{16}(4^5)$ orthogonal array, sixteen experimental runs were set for anodizing voltage, duration time and H_2O content in the electrolyte with four different levels. Scanning electron microcopy (SEM) images showed the various features of TiO_2 nanotubes anodized at different electrochemical conditions. The long neat nanotube with honeycomb-like structure was also formed in an array. The range analysis and variance analysis of DOE revealed that the voltage was the primary factor to influence the dimension of the anodized TiO_2 nanotubes. The sequence of influential factors was voltage > duration time > H_2O content. The optimal level for the H_2O content and duration time was 4 wt% and 3h, respectively. The surface wettability of Ti6Al4V alloy became hydrophilic and enhanced with the anodizing voltage increasing.

Keywords: anodization; TiO_2 nanotube arrays; orthogonal design; anodizing voltage; duration time; H_2O content

1. INTRODUCTION

Compared with the common surface of materials, arrays of TiO_2 nanotubes formed by anodization have gained much concern in last decade because of its nano-array feature on Ti or Ti alloy. The remarkable nano-characteristic is potentially promising in a wide field of application, including dye-sensitized solar cells [1], water splitting [2], drug delivery [3], and biomedical implants [4, 5]. Ti6Al4V alloy is successfully used in medical prosthesis and orthopedic and dental implants from the 1950s, owing to its plasticity, toughness, strength, weldability, corrosion resistance and biocompatibility. The implants failure generally occurs between the implant and the underlying bone

surface because of poor osseointegration, though a thin layer of passive and protective natural TiO_2 is formed on the surface. For enhancing the interaction between orthopedic implant and bone, the anodization of TiO_2 nanotube arrays on Ti alloy is a simple and practicable way to improve cell adhesion and to accelerate bone growth [6-8].

The growth of nanoporous TiO_2 film on Ti and Ti6Al4V alloy is firstly reported by Zwilling et al. in chromic acid media containing HF [9]. It is well known that TiO_2 nanotube arrays can grow up in two kinds of electrolyte, one is aqueous-based electrolyte, and the other is organic-based electrolyte. The fluoride ion in the electrolyte is necessary for the fabrication of the nanostructure on Ti and its alloys [10-12]. Using Ti or Ti alloy as anode, Pb as cathode, Gong et al. successfully fabricated the TiO_2 nanotubes in aqueous electrolyte containing HF [13]. However, in these early works, the tube length was of only few hundred nanometers with a relatively low degree of order. Since then, many researchers devoted to the anodization method to seeking for how to tune the morphology of TiO_2 nanotubes.

The geometric characteristics of nanotube arrays are determined by multiple factors, including anodizing voltage, duration time, temperature, electrolyte composition (including organic- or water-based electrolyte, pH, and water content) and its viscosity [7, 14, 15]. By tailoring the electrochemical parameters and the electrolyte concentration, Macak et al. achieved TiO_2 nanotubes with high aspect ratio in organic electrolyte [16]. The length of nanotubes can be controlled precisely from several to hundreds of micrometers when the organic-based electrolyte is used, such as ethylene glycol. In the past decades, both the field-assisted dissolution model and the “plastic flow” model are elaborated to illustrate the growth mechanism of nanotubes in fluoride-containing electrolytes [7, 10, 17-19]. In 2008, Zhu et al. introduced a growth model of oxygen bubble mould (OBM), which emphasizes that the oxygen bubble is the precondition of the oxide flow from the pore base to the pore wall [20, 21]. Until now, the mechanism is still in controversial and unclear. However, it is well known that the anodizing voltage, duration time and water content in electrolyte are important factors in the process of nanotube growth. To fabricate the highly ordered TiO_2 nanotube arrays on Ti or Ti alloy for further bone application, it is difficult to select the electrochemical conditions and to determine the electrolyte composition. The aim of this paper is to provide a systematic approach to grow highly-organized TiO_2 nanotube arrays on Ti6Al4V alloy by orthogonal design of experiments (DOE). The morphology of nanotube arrays is analyzed by scanning electron microscopy, and the surface wettability is measured by a contact angle meter.

2. MATERIAL AND METHODS

2.1 Materials

Ti6Al4V alloy (1mm thickness) was purchased from Chang’an Minglong Mould Steel (Dongguan, Guangdong). The samples of Ti alloy (10×10×1mm) were cut, and then mechanically polished with silicon carbide sandpaper of 400, 800, 1200 and 2000 grits successively. The surface of each sample was washed with acetone, ethanol and distilled water by ultrasonic for 15 min. NH_4F and

acetone were obtained from Beijing Chemical Works (Beijing), and ethylene glycol (EG) and absolute ethanol were obtained from Guangfu Fine Chemical Research Institute (Tianjin). All chemicals used in this study were of AR grade.

2.2 Orthogonal design of experiments

For experimental design, parameter optimization is a significant step to obtain a highly ordered TiO_2 nanotube arrays on Ti6Al4V alloy. In this study, the method of orthogonal experimental design was used. The different levels for anodizing voltage, duration time and H_2O content in the electrolyte were selected and listed in Table 1. According to the $L_{16}(4^5)$ orthogonal array, 16 experimental runs were set and shown in Table 2.

Table 1. Levels for anodizing voltage, time and H_2O content in the orthogonal experimental design

Levels	Factors		
	Voltage (V)	H_2O content (wt%)	Duration Time (h)
	A	B	C
I	20	2	2
II	30	3	3
III	40	4	4
IV	50	5	5

Table 2. Experimental runs in the orthogonal design using $L_{16}(4^5)$ orthogonal array

Experimental runs	Sample No.	Voltage (V)	H_2O content (wt%)	Duration time (h)
1	S1	AI	BI	CI
2	S2	AI	BII	CII
3	S3	AI	BIII	CIII
4	S4	AI	BIV	CIV
5	S5	AII	BI	CII
6	S6	AII	BII	CI
7	S7	AII	BIII	CIV
8	S8	AII	BIV	CIII
9	S9	AIII	BI	CIII
10	S10	AIII	BII	CIV
11	S11	AIII	BIII	CI
12	S12	AIII	BIV	CII
13	S13	AIV	BI	CIV
14	S14	AIV	BII	CIII
15	S15	AIV	BIII	CII
16	S16	AIV	BIV	CI

According to the H_2O content (table 1), the electrolyte was prepared by mixing EG, H_2O and 0.25 wt% NH_4F in a glass beaker at room temperature (about 25°C). Based on 16 experimental runs

listed in table 2, the anodization was performed in a two-electrode system with Ti alloy as the anode and plumbum foil as the cathode under an anodizing voltage supplied by a DH1720A-4 DC power source (60V1A, Dahua Electronic, Beijing, China). The distance between the two electrodes is kept at 3 cm in all anodizing process. After electrochemical anodization, the as-anodized TiO_2 nanotube arrays was rinsed with deionized water and then ultrasonicated in ethanol for 1 min.

2.3 TiO_2 nanotubes fabricated at different anodizing voltage

To detect the influence of anodizing voltage on the morphology of nanotube, the voltage gradient (including 20, 25, 30, 35, 40, 45, 50, 55, and 60 V) was performed to fabricate TiO_2 nanotubes in the electrolyte mixed with EG, 0.25 wt% NH_4F and 3 wt% H_2O for 3 h.

2.4. Characterization of TiO_2 nanotube arrays

The morphology of the TiO_2 nanotube arrays on Ti6Al4V was observed using field emission scanning electron microscope (QUANTA FEG250, FEI) at an accelerating voltage of 20 kV. Finally, the dimensions of TiO_2 nanotubes were measured using ImageJ software (NIH, USA). The mean and standard deviation (SD) were used to measure the dispersion of nanotubes.

The static water contact angle measurements of the TiO_2 nanotube arrays were carried out on a JY-82C contact angle analyzer (Chengde, China) to quantify the degree of hydrophilia. The scan area was 10 mm ×10 mm.

2.5 Statistical analysis

All data about the diameter of nanotubes was statistically analyzed using SPSS 13.0 for windows (SPSS Inc., Chicago, IL, USA). The range analysis and variance analysis were carried out for the orthogonal experimental design. $P < 0.05$ was set as the statistically significant.

3. RESULTS AND DISCUSSION

3.1 Morphology of TiO_2 nanotube arrays growth in fluoride-containing EG electrolytes

Figure 1 shows the SEM images of the TiO_2 nanotube arrays anodized at 20V using the orthogonal design of experimental method. In Figure 1a, the small nanopores have been grown on the surface of Ti6Al4V at 20V, 2.0 wt% H_2O for 2h. The porous layer partially covers on the nanotubes (Figure 1a and 1b). This is initiated during the first stage of growth, also called compact oxide layer [22]. The porous layer is absent on the nanotubes fabricated under other conditions. From the sectional view (inset of Figure 1), it is clear that the nanotubes are long, and the close-packed clusters of nanotube are formed at the top parts of the tubes, which is called nanograss. .

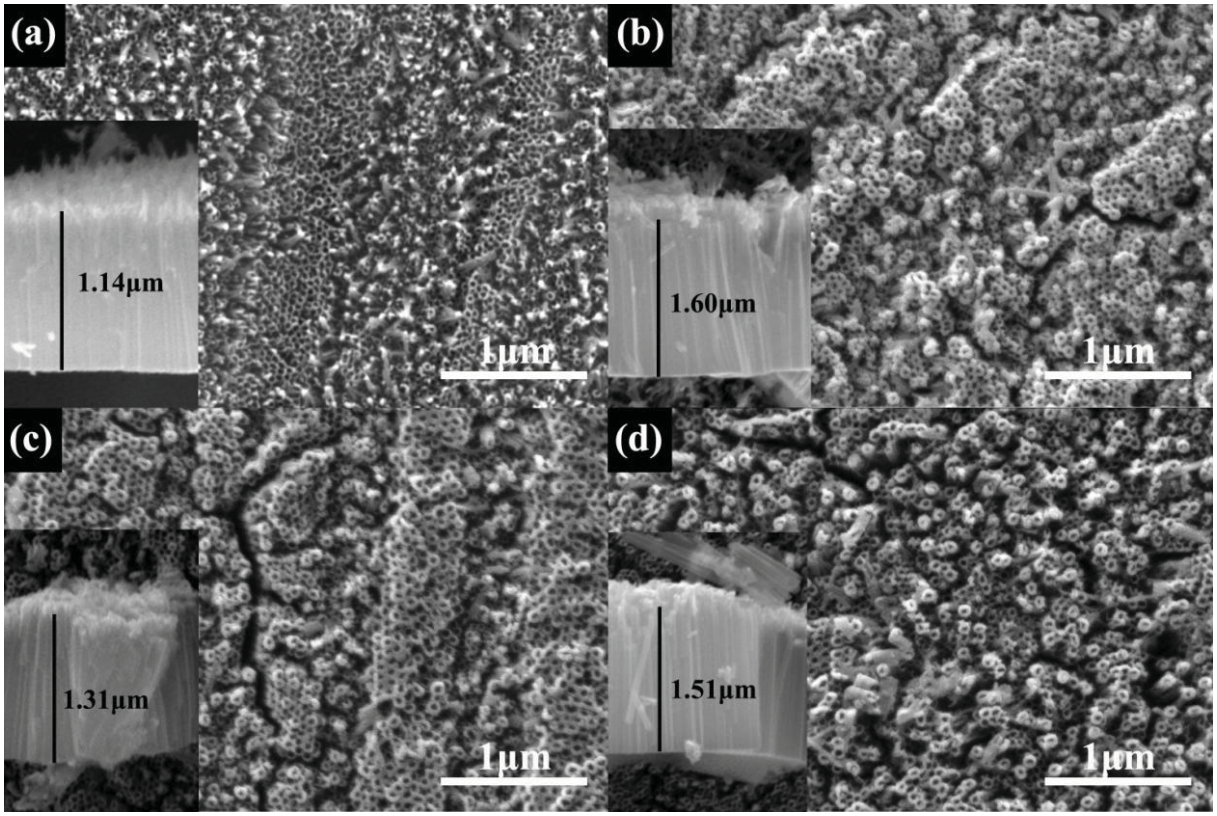

Figure 1. SEM images of TiO_2 nanotube arrays fabricated by anodization at 20V using orthogonal experimental design. (a) S1, (b) S2, (C) S3, (d) S4

In an electrochemical cell, anodization of a metal is a self-organized process to create porous or tubular oxide layer on metal substrate (anode or working electrode) with an inert counter electrode (usually platinum, carbon or plumbum). For aluminium, hexagonal nanoporous alumina is usually formed in fluoride-containing electrolytes. For Ti or Ti alloys, at an applied voltage, Ti^{4+} ions are driven from Ti substrate toward the electrolyte and a compact TiO_2 oxide layer grows initially on the anode surface because the water is electrolyzed to cause the field-assisted movement of ions (Eq. 1&2). Then, in the fluoride-containing electrolyte, the field-assisted dissolution at the metal-oxide interface (Eq 3) and chemical dissolution at the oxide-electrolyte interface (Eq. 4) are followed simultaneously to form tubular layer. It is shown as the following:

Metal oxidation: $Ti \text{ ----> } Ti^{4+} + 4e^-$ (Eq. 1)

Oxide layer formation: $Ti + 2H_2O \text{ ---> } TiO_2 + 4H^+$ (Eq. 2)

Field-assisted dissolution: $Ti^{4+} + 6F^- \text{ ----> } [TiF_6]^{2-}$ (Eq. 3)

Chemical dissolution: $TiO_2 + 6F^- + 4H^+ \text{ ----> } [TiF_6]^{2-} + 2H_2O$ (Eq. 4)

When the oxide growth at the metal-oxide interface under high field condition balances with the dissolution at the oxide-electrolyte interface, the steady state is reached, leading to the self-ordering nanotube growth, at the same time, the thickness of nanotubular layer remains unchanged.

According to the process of anodization, the applied voltage, duration time, and water content in electrolyte are the key factors when fabricating TiO_2 nanotubes. In organic electrolyte containing EG, the long nanotubes with high aspect ratio are generally obtained. However, with the duration time

extended, the top part of ordered long nanotubes disintegrated and transformed into nanograss. The formation mechanism of nanograss was fully elaborated because the nanotubes were bundled on the top surface of TiO_2-nanotubes [23-25]. The bundling of nanotubes is mainly induced by the over-etching of the top parts that are very thin and fragile [26]. Lee et al. [17] reported that the chemical etching thinned out and finally penetrated tube walls, resulting in some needle-like structures at the tube tops and collapse. Apart from the duration time, the morphology of nanotubes depends on the amount of H_2O in the electrolyte. The 8 % water content could result in the "ripples" on the wall of the nanotubes.

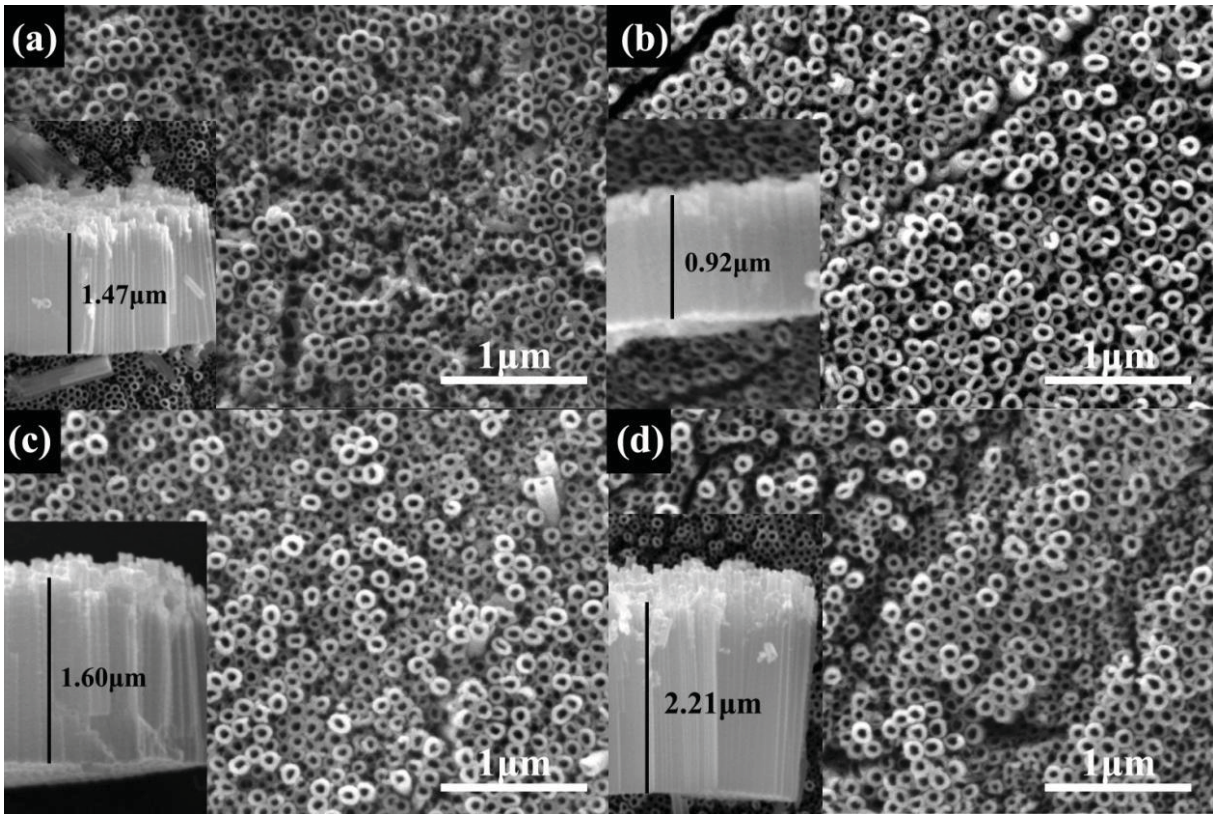

Figure 2. SEM images of TiO_2 nanotube arrays fabricated by anodization at 30V using orthogonal experimental design. (a) S5, (b) S6, (C) S7, (d) S8

Thus, to obtain the highly ordered arrays, the H_2O content is limited in the organic electrolyte. In this study, the different H_2O content is selected including 2 wt%, 3 wt%, 4 wt%, and 5 wt%. Figure 2 is the SEM images of TiO_2 nanotube arrays anodized at 30V. The comparatively neat TiO_2 nanotube arrays is formed on the surface of Ti6Al4V alloy. With the increase of H_2O content from 2 wt% to 5 wt%, the neat and distinct TiO_2 nanotube is anodized with the clear surface. At the same time, the ripples are observed on the tube wall from the inset sectional view of Figure 2c-d, but not found on the tube wall of Figure 2a. It is reported that the ribs at the tube wall are closely correlated with the water content in the electrolyte [27, 28]. No water-containing organic electrolyte result in very smooth nanotube without ripples. Berger et al. [28] studied the influence of 0-50 vol% water content in EG

electrolyte on the morphology change of anodic TiO_2. They observed that the ribs were formed at the side wall of aligned nanotubes at 2.5 vol% or higher water content. The reasonable formation mechanism of ripples was illustrated according to the different mechanism [10, 27]. Based on the filed-assisted dissolution mechanism, the formation of ribs is ascribed to the continuous etching and passivation of the cell boundary regions (a faster chemical dissolution speed than the growth speed of the tubes). However, Chong et al. set a series of experiments to prove that the ribs on the external tube walls resulted from the electrolyte entering into the wider gaps among the nanotubes due to the rupture of the entire surface layer by combining the 'plastic flow' model and the oxygen bubble model [21].

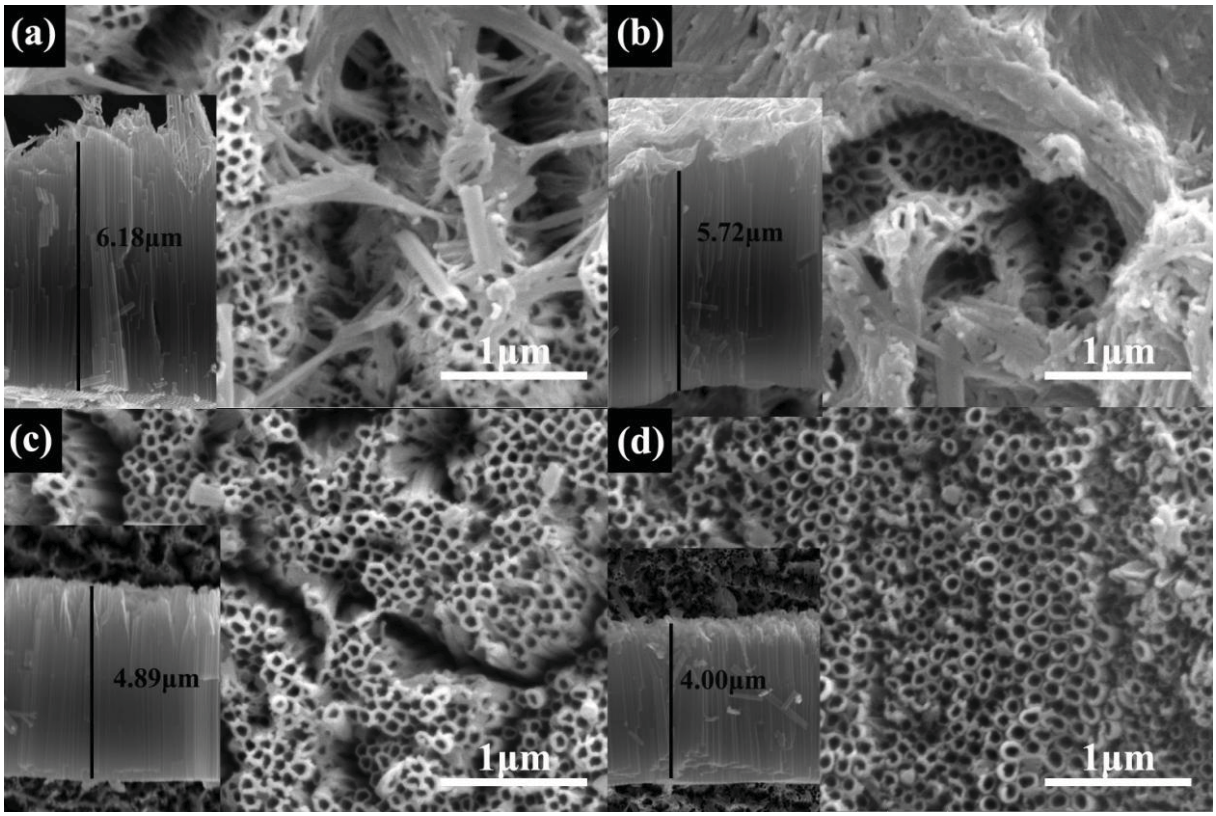

Figure 3. SEM images of TiO_2 nanotube arrays fabricated by anodization at 40V using orthogonal experimental design. (a) S9, (b) S10, (C) S11, (d) S12

Figure 3 is the SEM images of TiO_2 nanotube arrays anodized at 40V. The well-defined tubular structure is not shown under these conditions. The serous collapse and disintegrate of the top part of TiO_2 nanotubes are formed in EG electrolyte with 2 wt% H_2O for 4h and with 3 wt% H_2O for 5h, which are shown in Figure 3a and 3b, respectively. Though the collapse of nanotube is not occurred in EG electrolyte with 4 wt% H_2O for 2h (Figure 3C) and with 5 wt% for 3h (Figure 3D), the cluster of nanotubes and nanograss are viewed from the sectional view of Figure 3C and 3D (insets).

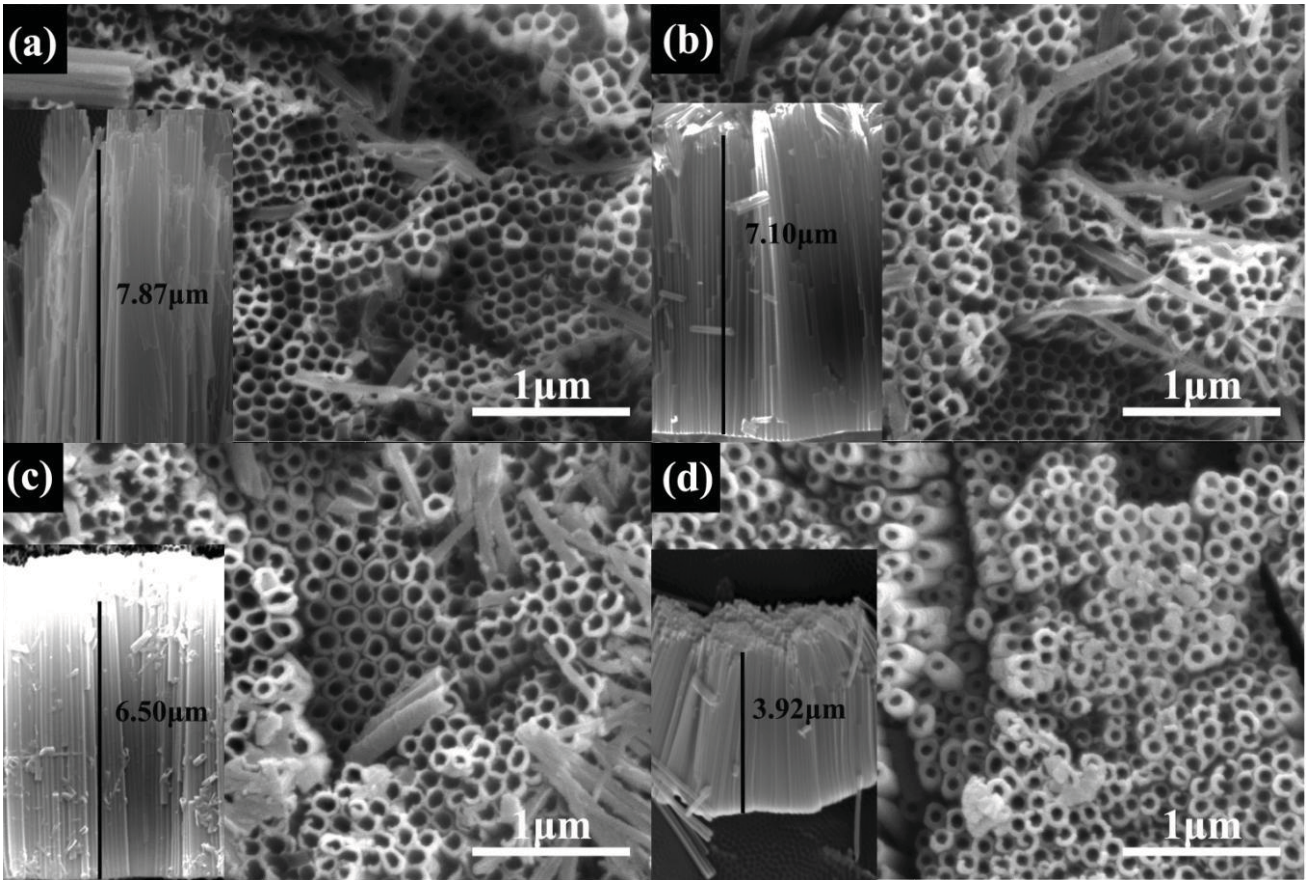

Figure 4. SEM images of TiO_2 nanotube arrays fabricated by anodization at 50V using orthogonal experimental design. (a) S13, (b) S14, (C) S15, (d) S16

Figure 4 is the SEM images of nanotube arrays anodized at 50V. The large diameter and the long neat nanotubes are formed. This is in line with earlier report that the anodizing voltage controls the tube diameter [29]. The tube length is adjusted by the duration time [30]. Generally, the nanotube is single and arranges in an array. However, the honeycomb-like tubular structure is occurred in the images of Figure 3a, c and Figure 4a, b. The wall of tube is thinned down, and it is too brittle and easy to crack.

The mean and standard deviation (SD) of the diameter for the anodized TiO_2 nanotubes are listed in Table 3. The orthogonal experimental design is to estimate the main effects and interaction independently in an orthogonal manner with a minimum number of runs in the experiment. The range analysis of orthogonal experimental design for the mean diameter of the anodized nanotubes is shown in Table 4a. From the range R, it is obvious that the voltage is the primary factor to influence the diameter size of the anodized nanotubes. The sequence of influential factors is voltage > duration time > H_2O content. The variance analysis of orthogonal experimental design for the mean diameter is analyzed using SPSS software, which is listed in Table 5a. The statistical significant difference is only existed for the voltage ($p < 0.05$), which is consistent with the result of range analysis. Further, the TiO_2 nanotube is anodized at different voltage. The diameter of anodized TiO_2 nanotubes is linear with the anodizing voltage, which is shown in Figure 6. The correlation coefficient R is 0.99.

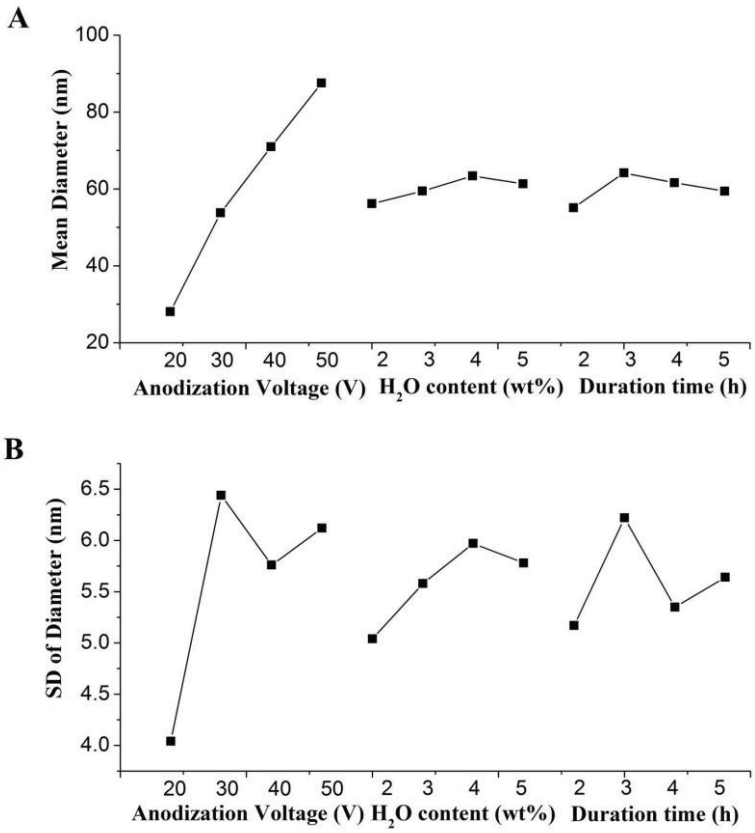

Figure 5. The trend diagram of each factor on the mean (A) and SD (B) of nanotubes diameter

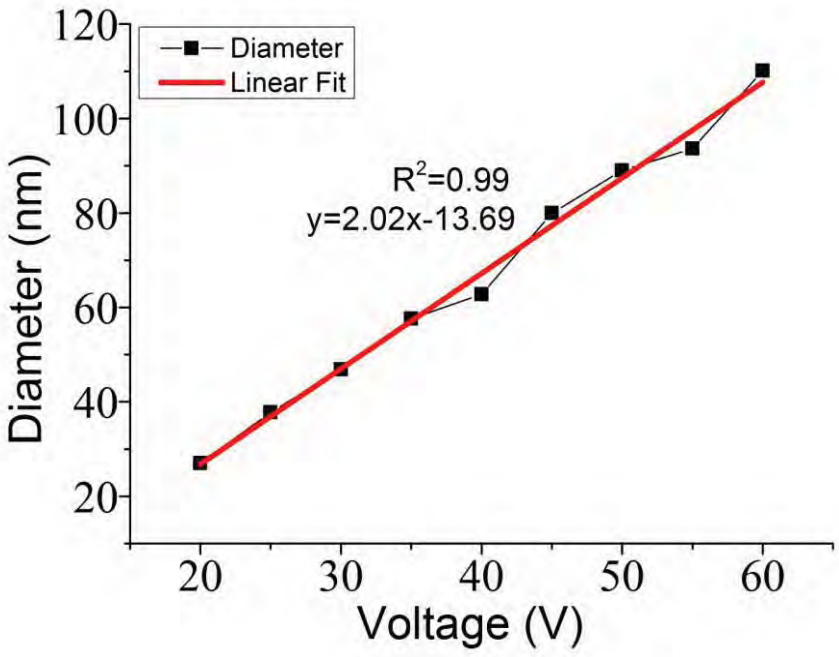

Figure 6. Linear correlation of the mean diameter of nanotubes with the anodizing voltage

Table 4b and 5b show the range analysis and variance analysis for the SD of the diameter for the anodized nanotubes. The range analysis indicates that the optimal factor affecting the SD of diameter is the voltage, and then is the duration time, and the minor factor is the water content. The influential sequence is voltage > duration time > H_2O content, which is consistent with that of the mean diameter. This result shows that the anodizing voltage is the first and most important factor in the process of TiO_2 anodization. The voltage not only is linearly correlated with the tubes diameter, but also closely determines the uniformity of anodized nanotubes though the significance is not existed ($F=1.856$, $p=0.238$, Table 5b). The trend diagram of each factor (Figure 5) indicates that the optimal level of the water content and duration time is 4 wt% and 3h, respectively.

Table 3. The mean and standard deviation (SD) of diameter for anodized TiO_2 nanotubes using orthogonal experimental design

Sample No.	Voltage (V)	H_2O content (wt%)	Duration time (h)	Mean Diameter (nm)	SD of Diameter (nm)
S1	20	2	2	25.5	5.0
S2	20	3	3	27.8	4.1
S3	20	4	4	32.4	2.9
S4	20	5	5	26.5	4.2
S5	30	2	3	49.1	6.3
S6	30	3	2	50.4	4.9
S7	30	4	5	53.8	7.1
S8	30	5	4	61.8	7.4
S9	40	2	4	68.8	4.7
S10	40	3	5	76.1	7.0
S11	40	4	2	63.3	5.3
S12	40	5	3	75.7	6.0
S13	50	2	5	81.3	4.2
S14	50	3	4	83.5	6.4
S15	50	4	3	104.1	8.5
S16	50	5	2	81.3	5.4

Table 4a. Range analysis of orthogonal experimental design for the mean diameter of the anodized nanotubes

Levels	Anodizing voltage (V)	H_2O content (wt%)	Duration time (h)
Ⅰ	28.0	56.2	55.1
Ⅱ	53.8	59.5	64.2
Ⅲ	71.0	63.4	61.6
Ⅳ	87.6	61.3	59.4
Range (R)	59.5	7.2	9.0
Optimal factor	Voltage > Time > H_2O content		

Table 4b. Range analysis of orthogonal experimental design for the standand deviation (SD) of diameter of the anodized nanotubes

Levels	Anodizing voltage (V)	H_2O content (wt%)	Duration time (h)
Ⅰ	4.04	5.04	5.17
Ⅱ	6.44	5.58	6.22
Ⅲ	5.76	5.97	5.35
Ⅳ	6.12	5.78	5.64
Range (R)	2.40	0.93	1.05
Optimal factor	Voltage > Time > H_2O content		

Table 5a. Variance analysis of orthogonal experimental design for the mean diameter of the anodized TiO_2 nanotubes

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model[a]	8045.323	9	893.925	16.932	0.001
Intercept	57768.123	1	57768.123	1094180	0.000
Voltage	7755.903	3	2585.301	48.968**	0.000
H_2O content	112.873	3	37.624	0.713	0.579
Duration Time	176.548	3	58.849	1.115	0.414
Error	316.775	6	52.796		
Total	66130.220	16			
Corrected Total	8362.098	15			

a: R Square=0.962 (Adjusted R Square=0.905)

Table 5b. Variance analysis of orthogonal experimental design for the standard deviation of diameter of the anodized nanotubes

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model[a]	18.162	9	2.018	0.820	0.621
Intercept	500.305	1	50.305	203.400	0.000
Voltage	13.694	3	4.565	1.856	0.238
H_2O content	1.918	3	0.639	0.260	0.852
Duration Time	2.550	3	0.850	0.346	0.794
Error	14.758	6	2.460		
Total	533.226	16			
Corrected Total	32.920	15			

3.2 Hydrophilicity of TiO_2-nanotubes surface

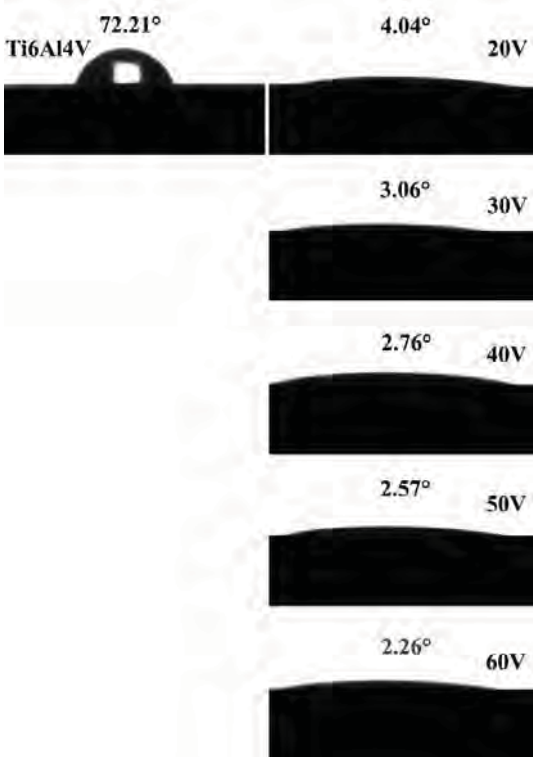

Figure 7. Contact angles of Ti6Al4V foil and TiO_2-nanotubes array anodized in the electrolyte containing EG, 0.25wt% NH_4F, and 4.0wt% H_2O for 3h.

Figure 7 shows the contact angle of Ti6Al4V and TiO_2-nanotubes film anodized in the electrolyte containing EG, 0.25wt% NH_4F, and 4 wt% H_2O content at 20V, 30V, 40V, 50V, and 60Vfor 3h, respectively. The Ti6Al4V alloy shows a hydrophobic surface with a contact angle of 72.21°. After anodization, the surface with TiO_2-nanotubes film becomes hydrophilic because the contact angle decreases to be smaller than that of Ti6Al4V surface. By determining the wettability of TiO_2-nanotubes surface anodized at 20V, 30V, 40V, 50V and 60V, the contact angle changes from 4.04° (20V) to 2.76° (40V), and then to 2.26° (60V). A study reported that the anodized TiO_2-nanoubular surfaces are transformed to hydrophilic surfaces regardless of anodization conditions [5]. This means that the anodization can change the surface wettability of the alloy and the film of TiO_2 nanotubes shows the good hydrophilicity. At high voltage, the diameter of TiO_2 nanotubes is large, and the contact angle is small. This indicates that the hydrophilicity of TiO_2-nanotubes film is enhanced with the increase of anodizing voltage.

4. CONCLUSIONS

Based on the method of orthogonal design of experiments (DOE), the highly-ordered TiO_2 nanotube arrays was successfully fabricated in EG electrolyte containing 0.25 wt% NH_4F. The

morphology of TiO_2 nanotube arrays was characterized by SEM. The nanoporous layer, the nanograss, the bundled top parts, the ripples on the wall of tubes, and the serious collapse and disintegrate of the top part of TiO_2 nanotubes were observed on Ti6Al4V alloy. The long neat nanotube with honeycomb-like structure was also formed and arranged in an array. The statistical analysis indicated that the anodizing voltage was the primary factor in fabricating the dimension of the TiO_2 nanotubes. The voltage was linearly correlated with the diameter of anodized TiO_2 nanotubes. The optimal level for the water content and duration time was 4 wt% H_2O and 3h, respectively. The contact angle measurements revealed the surface wettability of Ti6Al4V alloy was hydrophilic and enhanced with the anodizing voltage increasing.

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Review

Lung Injury Induced by TiO_2 Nanoparticles Depends on Their Structural Features: Size, Shape, Crystal Phases, and Surface Coating

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Abstract: With the rapid development of nanotechnology, a variety of engineered nanoparticles (NPs) are being produced. Nanotoxicology has become a hot topic in many fields, as researchers attempt to elucidate the potential adverse health effects of NPs. The biological activity of NPs strongly depends on physicochemical parameters but these are not routinely considered in toxicity screening, such as dose metrics. In this work, nanoscale titanium dioxide (TiO_2), one of the most commonly produced and widely used NPs, is put forth as a representative. The correlation between the lung toxicity and pulmonary cell impairment related to TiO_2 NPs and its unusual structural features, including size, shape, crystal phases, and surface coating, is reviewed in detail. The reactive oxygen species (ROS) production in pulmonary inflammation in response to the properties of TiO_2 NPs is also briefly described. To fully understand the potential biological effects of NPs in toxicity screening, we highly recommend that the size, crystal phase, dispersion and agglomeration status, surface coating, and chemical composition should be most appropriately characterized.

Keywords: TiO_2 nanoparticles; nanotoxicology; physicochemical property; lung injury; pulmonary inflammation

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1. Introduction

Owing to the rapid development of nanoscience and nanotechnology, many kinds of engineered nanoparticles (NPs) are needed and produced. It has been reported that there are more than 2800 nanoparticulate-based applications commercially available in various areas, such as electronics, materials, medicine and energy [1]. A new generation of materials, nanomaterials/nanoparticles are widely used in our daily life in water treatment, clothing, food additives, implants, and disease diagnosis, *etc.* Therefore, new issues are raised by researchers and scientists regarding the potential health effects and environmental impact of NPs [2–5].

Nanoscale titanium dioxide (TiO_2, diameter < 100 nm), one of the most commonly manufactured NPs, is a noncombustible and odorless white powder that is employed as a white pigment in paints and papers, a photocatalyst in solar cells, an optical coating in ceramics, and a corrosion-protective coating in bone implants, *etc*. It naturally exists in three crystal structures: anatase (tetragonal), rutile (tetragonal), and brookite (orthorhombic). Anatase and rutile TiO_2 both have a tetragonal structure, while the TiO_6 octahedron of anatase TiO_2 is distorted to be larger than that of the rutile phase [6]. Rutile TiO_2 is stable at most temperatures, while anatase is not at an equilibrium phase and is kinetically stabilized. At temperatures between 550 and 1000 °C, anatase transforms to the equilibrium rutile phase. Brookite TiO_2 is formed with the edge-sharing TiO_6 octahedron and has a larger cell volume. This form of TiO_2 is not often used in research. TiO_2 has a very low dissociation constant in water and aqueous systems, thus, it is insoluble in water and organic solvents, as well as under physiological conditions.

Generally, TiO_2 is considered a poorly soluble, low toxicity NP [7–9]. However, Ferin *et al.* observed that ultrafine TiO_2 (~20 nm) accessed the pulmonary interstitium. The acute inflammatory response was indicated in this study by polymorphonuclear (PMN) leukocytes among lavaged cells in rat lung after acute instillation and subchronic inhalation [10]. Oesch and Landsiedel [11] reviewed the genotoxicity of nanomaterials, including nanosized TiO_2, which varied in the test systems used. Positive and negative results were obtained in the DNA damage and gene/chromosome mutation tests. When different sizes of the same form of TiO_2 were tested in the same laboratory, smaller material induced DNA damage and micronuclei formation while large size material did not [11].

Among the several routes of nanosized TiO_2 exposure, inhalation is apparently a more general and important route of exposure to NPs than others like injection, ingestion, and dermal penetration. A few epidemiologic studies have surveyed the carcinogenicity of TiO_2 in workers employed in TiO_2 production factories by considering the pathophysiology, gender, age and exposure pathways, which were reviewed by NIOSH in 2005 [12]. There is little clear evidence of elevated risks of lung cancer mortality or morbidity among workers exposed to TiO_2 dust [13–15]. In 2006, the International Agency for Research on Cancer (IARC) classified pigment-grade TiO_2 as “possibly carcinogenic to human beings (Group 2B)”, based on the carcinogen policy of the Occupational Safety and Health Administration (OSHA), according to sufficient evidence of carcinogenicity in animals and inadequate evidence for human carcinogenicity [16].

The lung is a primary target organ of NPs exposure via inhalation in the occupational setting. The spectrum of the toxic effects of nanoscale TiO_2 on pulmonary responses has raised much concern. When searching for “nano TiO_2 and pulmonary” in PubMed, there are 531 results, and of those results,

over one-half (304 results) has been published in the last 10 years, and approximately 40% (nearly 207 papers) have been published in the last five years. An increased incidence of lung injury and pulmonary inflammation induced by exposure to TiO_2 NPs has been reported in the scientific literature. Sub-chronic and chronic (inhalation or intratracheal instillation) studies have revealed that TiO_2 NPs are deposited in the lung and translocated to the lymph nodes [5,17–19]. The overload of TiO_2 NPs in the lung can exceed the ability of the macrophages to phagocytose and, eventually, transfer across the epithelium and migrate to the deeper pulmonary interstitium to induce the pulmonary inflammatory response in a dose-dependent manner. The most commonly reported biomarkers are largely detected by analyzing the bronchoalveolar lavage fluid (BALF) propertied and the pathology of the lung *in vivo*. An increased number of macrophages and neutrophils, fibroproliferative lesions and epithelial hypertrophy and hyperplasia in lung alveoli have been observed in exposed animals [20–26]. The clearing of particles from the alveolar region is much slower and may take weeks to years. Rats, mice and hamsters show different lung burden and clearance patterns for TiO_2 NPs, and hamsters are better able to clear TiO_2 NPs than similarly exposed mice and rats [14,17,18]. The pulmonary toxicity and tissue injury elicited by TiO_2 NPs is based on several physical and chemical properties, which have been reported in many studies [27–30].

Dose is traditionally considered in toxicity screening. Paracelsus noted, “The right dose differentiates a poison and a remedy.” However, the interaction of TiO_2 NPs with a biological system is closely correlated with their structural features including size, shape, crystal phase, and surface coating. In this paper, we will concentrate systematically on the influence of physicochemical features of TiO_2 NPs on lung toxicity and pulmonary cell impairment. Although many related studies have been published recently, only selected representative works are cited here. The aim is to understand the correlation of the physicochemical properties of TiO_2 NPs with their potential hazardous effects on lung tissue and to help improve their application performance.

2. Structural Features of TiO_2 Nanoparticles

2.1. Size

Size is a key factor for nanoparticles. Based on an agreement on the size of nanoparticles among the groups of standards (International Organization for Standardization (ISO), American Society for Testing and Materials (ASTM), and Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR)), the scale from 1 to 100 nm defines the size range of a nanoparticle [31]. The properties of particles change as the size approaches nanoscale. The percentage of atoms becomes significant at the surface of NPs, and there are many active sites on the particle surface. Therefore, many researchers in “nanotoxicology” aim to elucidate the interaction of nanoparticles with biological systems and the mechanism(s) by which they act. For an overview, the lung toxicological effect in animal models and cytotoxicity of TiO_2 NPs with different structural features were listed in Tables 1 and 2. In 1992, Ferin *et al.* [10] first reported that the ultrafine TiO_2 particles (~20 nm) were translocated to the lung interstitium to a greater extent and cleared from the lungs more slowly than fine TiO_2 particles (~250 nm) in Fischer 344 rats after the intratracheal instillation of 500 μg of TiO_2. Based on a predictive mathematical model (ICRP 1994) [32], Obserdorster *et al.* [5] figured out the

fractional deposition of inhaled particles in different regions of the human respiratory tract, including three regions—the extrathoracic (mouth or nose and throat), the trachea-bronchial and the alveolar regions. NPs mainly deposit in the alveolar region, with approximately 50% of the 20-nm particles depositing efficiently in the alveolar region and only ~15% of this particle size depositing in tracheobronchial and nasopharyngeal regions. This model also supports another report that TiO_2 particles (~20 nm) highly accessed the lung interstitium of the rat more than fine TiO_2 particles (less than 200 nm) at an equal mass dose [20], resulting in the influx of PMNs into the alveolar space and a large acute pulmonary inflammatory reaction in BALF.

Alveolar macrophages (AM), as phagocytic cells, reside on the alveolar epithelium and clear solid particles through phagocytosis. The macrophage ability of AM has been compared in commercial ultrafine and fine TiO_2 particles both *in vitro* and *in vivo*. Renwick *et al.* [33] reported that the ultrafine TiO_2 (29 nm mean diameter, 50 m^2/g surface area) significantly reduced the ability of J774.2 mouse AM to phagocytose 2 μm indicator latex beads more than the fine TiO_2 (250 nm mean diameter, 6.6 m^2/g surface area). Oberdörster *et al.* [34] compared the AM-mediated clearance of the same mass of ultrafine TiO_2 (20 nm) and fine TiO_2 (250 nm) in the rat. They reported that a volumetric loading of 9% with fine TiO_2 caused a retention half-time of 117 days, whereas a volumetric loading of 2.6% with ultrafine TiO_2 caused a prolongation of the clearance half-time (541 days). Gibbs-Flournoy *et al.* [35] also detected that 27-nm TiO_2 was internalized into human bronchial epithelial (BEAS-2B) cells and proximity to cellular nuclei with time using darkfield and confocal laser scanning microscopy (DF-CLSM). For any given mass of particles, as particle size decreases, the total particle surface area increases dramatically [5]. The larger particle the surface area is, the greater the toxicity that the ultrafine particles will develop [20]. For the 29 and 250 nm TiO_2, the specific surface area is 50 and 6.6 m^2/g, respectively. After receiving 0.1 mg of nanoscale TiO_2 (rutile, 21-nm average particle size; specific surface area of 50 m^2/g), the lungs of ICR mice showed significant changes in morphology and histology, including the disruption of alveolar septa and alveolar enlargement (indicating emphysema), type II pneumocyte proliferation, increased alveolar epithelial thickness, and an accumulation of particle-laden AM [36]. On the contrary, after instillation with 1 mg fine TiO_2 (250 nm mean diameter, specific surface area of 6.6 m^2/g), the mice showed no inflammatory cells or expression of inflammatory cytokines in the lung tissue at 4, 24, or 72 h [37]. Rats treated with ultrafine TiO_2 (29 nm), but not fine TiO_2 (250 nm), by instillation had an increased percentage of neutrophils, γ-glutamyl transpeptidase concentration (a measure of cell damage), protein concentration (a measure of epithelium permeability), and lactate dehydrogenase (LDH) in BALF [33]. The genotoxicology of nanosized TiO_2 particles on human bronchial epithelial cells was investigated in a size-dependent manner. Nanosized TiO_2 particles (10 and 20 nm) induced the oxidative DNA damage by the strand breaks and base damage in the absence of light, but larger sized TiO_2 (>200 nm) did not induce any DNA damaging events [38].

Table 1. Lung toxicity in animal models induced by different TiO_2 particles.

Structural Feature	Animals	Dose	Exposure Route	Toxicity Effect	Reference
Ultrafine TiO_2 (~20 nm), Fine TiO_2 particles (~250 nm)	Rats	23.5 and 22.3 mg/m^3	Intratracheal instillation for 6 h per day, 5 day per week for 12 weeks	Ultrafine particles at equivalent masses access the pulmonary interstitium to a larger extent than fine particles; pulmonary clearance of ultrafine particles was slower ($t½$ = 501 days) than of larger particles ($t½$ = 174 days); a similar mass deposition of the two particle types in the lower respiratory tract; ultrafine particles elicited a persistently high inflammatory reaction compared to the larger-sized particles; this correlated well with their greater surface area per mass.	[10,34]
Ultrafine TiO_2 (~20 nm), larger TiO_2 particles (less than 200 nm)	Rats		Intratracheal instillation	Ultrafine particles highly access the pulmonary interstitium; PMNs influx into the alveolar space; The acute inflammatory reaction including an increased percentage of neutrophils, γ-glutamyl transpeptidase concentration (a measure of cell damage), protein concentration (a measure of epithelium permeability), and lactate dehydrogenase (LDH) in BALF were induced.	[20]
Rutile nano-TiO_2 (21 nm)	Mice	0.1, and 0.5 mg	Intratracheal instillation for one time	Pulmonary emphysema, extensive disruption of alveolar septa, type II pneumocyte hyperplasia, epithelial cell apoptosis, and accumulation of particle-laden macrophages were induced.	[36]
Fine TiO_2 (250 nm mean diameter)	Mice		Intratracheal instillation for 4, 24, or 72 h	Inflammatory cells or expression of inflammatory cytokines were not detected in the lung tissue.	[37]
Ultrafine TiO_2 particles (1.4 μm)	Mice, Rats, Hamster	10, 50, and 250 mg/m^3	Inhalation for 6 h per day, 5 day per week for 12 weeks	Species differences in pulmonary responses: rats developed a more severe and persistent pulmonary inflammatory response than either mice and hamsters; hamsters are better able to clear TiO_2 NPs than similarly exposed mice and rats.	[17,18]
Anatase TiO_2 nanospheres, short belts (1–5 μm), long nanobelts (4–12 μm)	Mice	0–30 μg	Pharyngeal aspiration	Both nanospheres and long nanobelts resulted in the lung deposition of 135 μg TiO_2. At 112 day after exposure, the lung burden was significantly lower in nanosphere-exposed mice than in nanobelt-exposed mice.	[39]
Rutile TiO_2 nanorods	Wistar Rats	1, and 5 mg/kg	Intratracheal instillation for 24 h	Inflammation responses were examined in BALF (significantly increased neutrophilic inflammation) and whole blood (significantly reduced platelets and elevated numbers of monocytes and granulocytes) at doses of 1 or 5 mg/kg.	[40]

Table 1. *Cont.*

Structural Feature	Animals	Dose	Exposure Route	Toxicity Effect	Reference
Nanoscale TiO_2 rods (anatase = 200 nm × 35 nm), nanoscale TiO_2 dots (anatase = similar to 10 nm)	Rats	1 and 5 mg/kg	Intratracheal instillation	Produced transient lung inflammation and cell injury in rats at 24 h post-exposure, which is similar to the pulmonary effects of rutile TiO_2 NPs (300 nm).	[41]
Anatase/rutile spheres (TiO_2-P25), anatase spheres (TiO_2-A), anatase nanobelts (TiO_2-NBs)	Mice and Rats	20, 70, and 200 μg	Intratracheal instillation	TiO_2-A, TiO_2-P25, and TiO_2-NB caused significant neutrophilia in mice at 1 day in three of four labs, and this effect was resolved by day 7; TiO_2-P25 and TiO_2-A had no significant effect in rats in any of the labs; Only TiO_2 nanobelts caused significant neutrophilia in rats at 1 day after intratracheal instillation in two or three of four labs.	[42,43]
Base TiO_2 particles, TiO_2 particles coated with aluminum oxide (0%–6%) and/or silica (0%–11%)	Rats	2 and 10 mg/kg; 1130–1300 mg/m^3 (high dose)	Intratracheal inhalation and instillation for 4 weeks	Surface-coated TiO_2 produced higher pulmonary inflammation (PMNs in BALF) than the uncoated TiO_2 at 24 h in SD rats, but this effect was only a short-term, transient lung inflammatory response and was reversible at one week post-exposure; Surface treatments influenced the toxicity of TiO_2 particles.	[44]
In situ-produced TiO_2 (~21 nm), rutile (<5 μm), nanosized rutile/anatase (~30 nm), nanosized anatase (<25 nm), silica-coated nanosized needle-like rutile (~10 × 40 nm)	Mice	10 mg/m^3	Inhalation for 2 h, 4 consecutive days, 4 weeks	Only SiO_2-coated rutile commercial TiO_2 NPs elicited clear-cut pulmonary neutrophilia, increased expression of tumor necrosis factor (TNF)-α and neutrophil-attracting chemokines; The level of lung inflammation could not be explained by the surface area of the particles, their primary or agglomerate particle size, or free radical formation capacity but was rather explained by the surface coating.	[45]
Hydrophobic and silanized ultrafine TiO_2	Rats	250 and 500 μg	Intratracheal instillation	Silanized TiO_2 did not show toxicity, but a much lower pulmonary inflammation was induced in comparison to the hydrophilic uncoated TiO_2 in rat lung; Surface properties (surface chemistry) appeared to play an important role in ultrafine particle toxicity.	[46]
Pristine TiO_2 NPs, TiO_2 NPs embedded in paints	Mice	20 μg	Oropharyngeally aspiration once a week for 5 weeks	The paint containing TiO_2 ENPs did not modify macrophage and neutrophil counts, but mildly induced KC and IL-1β; The incorporation of TiO_2 NPs in aged paint matrix blocked most of the particle-induced lung and systemic blood toxicity.	[47]

Table 1. *Cont.*

Structural Feature	Animals	Dose	Exposure Route	Toxicity Effect	Reference
Rutile TiO_2 NPs coated with alumina (uf-1), rutile TiO_2 NPs coated silica/alumina (uf-2), uncoated anatase/rutile TiO_2 (uf-3)	Rats	1 or 5 mg/kg	Intratracheal instillation	uf-1 and uf-2 produced transient lung inflammation, and uf-3 produced pulmonary inflammation, cytotoxicity and adverse lung effects, and aggregated macrophages in the alveolar regions of the lung; uf-3 particles showed more chemical reactivity than both uf-1 and uf-2 particles.	[48]
Surface-coated rutile TiO_2 (~20.6 nm) (coating content: silicon, aluminum, zirconium and polyalcohol)	Mice	18, 54, and 162 μg	Intratracheal instillation for one time	Nano-TiO_2 deposited in the lung; 3000 genes were altered in the pulmonary system; At low doses, surface-coated rutile TiO_2 potentially down-regulated several gene expression associated with ion homeostasis and muscle function in the absence of inflammation.	[27]
Commercially TiO_2 P25 untreated with hydrophilic surface, TiO_2 T805 silanized with hydrophobic surface	Rats	0.15, 0.3, 0.6 and 1.2 mg	Instillation for one time	There was no inflammation or persistent DNA damage in the lung of rats exposed to two types of commercial TiO_2 at low doses administered.	[49]
Fine (180 nm) and ultrafine (20–30 nm) TiO_2 particles (hydrophilic), surface modified with methylation (hydrophobic)	Rats	1 and 6 mg	Intratracheal instillation for 16 h	A lesser inflammatory response (influx of neutrophils, activated PMNs and total cell number) was induced in rats in comparison to the untreated TiO_2; the impact of surface methylation on TiO_2 toxicity was negligible; surface area rather than hydrophobic surface determined the pulmonary inflammation.	[50]

Table 2. Cytotoxicity of TiO_2 particles with different structural features.

Structural Feature	Cell Line	Dose and Exposure Time	Cytotoxicity Effect	Reference
Ultrafine TiO_2 (29 nm mean diameter, 50 m^2/g surface area), fine TiO_2 (250 nm mean diameter, 6.6 m^2/g surface area)	Macphage cell line (J774.2)	125.45 mg/mL for 4, 8, 24, and 48 h	Ultrafine and fine particles had no significant cytotoxic effects on J774.2 AM ultrafine TiO_2 significantly impair the ability of J774.2 mouse AM to phagocytose 2 μm indicator latex beads more than the fine TiO_2.	[33]
27 nm TiO_2 particles	Human bronchial epithelial cells (BEAS 2B)		27 nm TiO_2 was internalized into BEAS-2B cells and proximity to cellular nuclei between 5 min and 2 h.	[35]
Nanosized TiO_2 particles (10 and 20, 200 nm)	BEAS 2B		Nanosized TiO_2 particles (10 and 20 nm) induced the oxidative DNA damage, lipid peroxidation, and micronuclei formation in the absence of light, but larger sized TiO_2 (>200 nm) did not induce any oxidative stress and DNA damaging events; rutile-sized 200 nm particles induced hydrogen peroxide and oxidative DNA damage in the absence of light but the anatase-sized 200 nm particles did not.	[38]
Spherical TiO_2 NPs (12–140 nm; both anatase and rutile)	Human lung carcinoma epithelial cell line (A549 cells)		Single strand breaks, oxidative lesions to DNA and oxidative stress were induced; the cells ability to repair DNA was impaired.	[51,52]
TiO_2-based nanofilaments	Human lung tumor cells (H596)	0.01, 0.1, 1, and 2 μg/mL	TiO_2-based nanofilaments (2 μg/mL) impaired cell proliferation and cell death in a dose-dependent manner; The short (<5 μm) needle-like structures were taken up by H596 cells and clustered and gathered around the cell nucleus.	[53]
TiO_2 nanobelts: short (<5 μm) long (>15 μm)	Primary murine alveolar macrophages	100 μg/mL	The 15-μm nanobelts were highly toxic, involving the loss of lysosomal integrity and the release of cathepsin B. These fiber-shaped nanomaterials induced inflammasome activation and the release of inflammatory cytokines in a manner very similar to asbestos or silica.	[54]

Table 2. *Cont.*

Structural Feature	Cell Line	Dose and Exposure Time	Cytotoxicity Effect	Reference
0-D TiO_2 nanoparticles, 1-D TiO_2 nanorods, 3-D TiO_2 assemblies	HeLa cells	125 μg/mL	0-D anatase NPs decreased cell viability to a level of 80% at 125 μg/mL, and cell viability of 1-D and 3-D structures remained close to 100%; 0-D TiO_2 NPs and 1-D nanorods could be readily internalized into the cells and the spherical particles were taken up more than the rod-shaped particles of similar size; 3-D assembled aggregates of TiO_2 were less likely to be incorporated into cells.	[55]
Anatase/rutile spheres (TiO_2-P25), anatase spheres (TiO_2-A), anatase nanobelts (TiO_2-NBs)	Human monocyte/macrophage cell line (THP-1)	10, 25, 50, and 100 μg/mL for 24 h	TiO_2 was not cytotoxic except for the nanobelt form, which was cytotoxic and induced significant IL-1β production in THP-1 cells.	[56]
Anatase and rutile TiO_2 NPs	A549		Anatase TiO_2 produced greater cell responses and was more toxic than rutile by MTT and XTT assay. Differences in biological response of NPs occurred as a function of size, crystalline phase and chemical composition.	[57]
Nanocrystalline TiO_2 (anatase and rutile)	A549 and human dermal fibroblasts (HDF) cell line	100 μg/mL	Anatase was 2 orders of magnitude more cytotoxic (LC_{50} of 3.6 μg/mL) than similarly sized rutile counterparts (LC_{50} of 550 μg/mL) by determining cell viability and LDH release; The most cytotoxic NPs were the most effective for generating ROS, and were more likely to generate damaging RS species in cell culture.	[58]
Nanosized anatase (<25 nm), nano-sized rutile with SiO_2 coating, and fine rutile (<5 μm)	BEAS-2B, Chinese hamster lung fibroblast (V79) cells	1–100 μg/cm^2 for 24, 48, and 72 h	Nano-sized anatase and fine rutile induced DNA damage at doses of 1 and 10 μg/cm^2, while SiO_2-coated rutile induced DNA damage only at 100 μg/cm^2. Only nanosized anatase could elevate the frequency of micronucleated BEAS-2B cells.	[59,60]
Anatase and rutile TiO_2 NPs (6.3, 10, 50, and 100 nm)	Mouse keratinocyte cell line (HEL-30)	0, 10, 25, 50, 100, and 150 μg/mL for 24 h	Anatase TiO_2 NPs could induce cell necrosis, whereas rutile TiO_2 NPs could initiate apoptosis through the formation of ROS.	[61]

Table 2. *Cont.*

Structural Feature	Cell Line	Dose and Exposure Time	Cytotoxicity Effect	Reference
Uncoated TiO_2 (anatase and rutile), polyacrylate-coated nano-TiO_2	Chinese hamster lung fibroblast (V79) cells	10 and 100 mg/L for 24 h	Both coated and uncoated TiO_2 (anatase and rutile) decreased the cell viability in a mass- and size-dependent manner; TiO_2 NPs coated with polyacrylate were only cytotoxic at high concentration (100 mg/L), and only uncoated nano-TiO_2 induced DNA damage.	[60]
Functionalized TiO_2 NPs with various surface groups (–OH, $-NH_2$, and –COOH)	Lewis lung carcinoma, 3T3 fibroblasts	0.01, 0.1, 1, and 10 mg/L for 24 h	$–NH_2$ and –OH groups showed significantly higher toxicity than –COOH; the decreased cell viability was associated with TiO_2 particles-induced protein aggregation/denaturation and subsequent impaired cell membrane function.	[62]
Rutile (<5 μm), nanosized rutile/anatase (~30 nm), nanosized anatase (<25 nm), silica-coated nanosized needle-like rutile (~10 × 40 nm) (cnTiO_2)	Murine macrophages RAW 264.7; Human pulmonary fibroblasts (MRC-9)	20, 30, 100, 300 μg/mL for 6 h	cnTiO_2 elicited significant induction of TNF-α and neutrophil-attracting chemokines. Stimulation of human fibroblasts with cnTiO_2-activated macrophage supernatant induced high expression of neutrophil-attracting chemokines, CXCL1 and CXCL8.	[45]
Pure anatase and rutile TiO_2	Human alveolar type-I-like epithelial cell (TTI)		These two nano-TiO_2 forms mediated a similar profile and pattern of inflammatory response; pure rutile caused a small, but consistently greater response for IL-6, IL-8 and MCP-1; the temporal induction of oxidative stress varied markedly between the two nano-TiO_2 forms.	[63]

At the nano level, TiO_2 NPs at a given size can agglomerate in different sizes and structures. Influence of the agglomeration of TiO_2 NPs on pulmonary toxicity has been investigated by Noël *et al.* [64–66]. One study reported that rats exposed to small agglomerates (<100 nm) of 5 nm TiO_2 by inhalation showed greater cytotoxic and oxidative stress responses than rats exposed to larger agglomerates (>100 nm) of the same NPs, which only induced a slight inflammatory reaction [64]. In a follow-up study, the authors compared the agglomeration state with different primary sizes of TiO_2 NPs (5, 10–30 and 50 nm) [66]. The results showed that for an agglomeration state smaller than 100 nm, the 5-nm particles caused a significant increase of LDH activity (cytotoxic effects) compared to controls, while oxidative damage measured by 8-isoprostane concentration was less when compared to 10-, 30- and 50-nm particles. This indicates that the initial particle size and agglomeration state of TiO_2 NPs are important factors for the lung inflammatory reaction and cytotoxic and oxidative stress responses.

2.2. Shape

TiO_2 NPs or nanospheres are generally considered to have cytotoxicity effects, which have been thoroughly assessed and published. Jugan *et al.* [51,52] reported that spherical TiO_2 NPs (12–140 nm; both anatase and rutile) induced single strand breaks, oxidative lesions to DNA and oxidative stress in A549 cells (human lung carcinoma epithelial cell line). They also showed that TiO_2 NPs impair the cells ability to repair DNA by deactivating both the nucleotide excision repair (NER) and the base excision repair (BER) pathways.

Other than zero-dimensional TiO_2 NPs (nanospheres), one-dimensional TiO_2 nanostructures are the most synthesized and widely used including nanorods, nanobelts, and nanotubes, *etc*. The shape of TiO_2 NPs has an effect on their deposition in the lung. The exposure of mice to various shapes of anatase TiO_2 (nanospheres, short belts of 1–5 μm, and long nanobelts of 4–12 μm) resulted in the lung deposition of 135 μg for the animals exposed to both nanospheres and long nanobelts. At 112 day after exposure, the lung burden was significantly lower in nanosphere-exposed mice than in nanobelt-exposed mice [39]. Several works report the interaction of NP shape with lung tissue or pulmonary cells. In a study of rutile TiO_2 nanorods, inflammation responses were examined in BALF (significantly increased neutrophilic inflammation) and whole blood (significantly reduced platelets and elevated numbers of monocytes and granulocytes) in Wistar rats 24 h after intratracheal instillation at doses of 1 or 5 mg/kg [40]. Warheit *et al.* [41] showed that instilled nanoscale TiO_2 rods (anatase = 200 nm × 35 nm) and nanoscale TiO_2 dots (anatase = similar to 10 nm) produced transient lung inflammation and cell injury in rats at 24 h post-exposure, which is similar to the pulmonary effects of rutile TiO_2 NPs (300 nm). The cytotoxic effect of TiO_2-based nanofilaments on H596 human lung tumor cells have been evaluated [53]. The addition of TiO_2-based nanofilaments (2 μg/mL) impaired cell proliferation and cell death in a dose-dependent manner. The short (<5 μm) needle-like structures were taken up by H596 cells and clustered around the cell nucleus. Hamilton *et al.* [54] synthesized the short (<5 μm) and long (>15 μm) TiO_2 nanobelts and tested their biological activity using primary murine alveolar macrophages and mice. The 15-μm nanobelts were highly toxic, involving the loss of lysosomal integrity and the release of cathepsin B. These fiber-shaped nanomaterials induced the inflammasome activation and the release of inflammatory cytokines in a

manner very similar to asbestos or silica. At the lowest-observed-effect level (LOEL), only the anatase TiO_2 nanobelt displayed significant inflammation in the BALF of Sprague Dawley (SD) rats 1 day after intratracheal instillation compared with anatase/rutile P25 spheres (TiO_2-P25) and pure anatase spheres [42]. The various morphological classes of TiO_2 nanostructures, including zero-, one-, and three-dimensional (0-D, 1-D, and 3-D) anatase assemblies, have been evaluated [55]. At a concentration of 125 μg/mL, 0-D anatase NPs decreased cell viability to a level of 80%, and the cell viability of 1-D and 3-D structures remained close to 100%. The cellular uptake experiment showed that 1-D nanorods and 0-D TiO_2 NPs could be readily internalized into the cells after 24 h incubation. The spherical particles were taken up more than the rod-shaped particles of similar size. The more sterically unwieldy, highest surface area 3-D aggregates of TiO_2 were less likely to be incorporated into cells. The National Institute of Environmental Health Science (NIEHS) Nano GO Consortium conducted a series of coordinated inter-laboratory research with different shapes of TiO_2 both *in vitro* and *in vivo*. The results showed that only the TiO_2 nanobelt form was toxic; it induced significant IL-1β production in THP-1 (human monocyte/macrophage cell line) cells, and caused significant neutrophilia in mice and rats at 1 day after intratracheal instillation in two or three of four labs. However, no significant toxicity effect was observed *in vitro* for TiO_2 spheres in any of the labs [43,56].

2.3. Crystal Phase

Anatase and rutile have different crystal lattices. Rutile is considered as an inert form, whereas anatase is an active form of TiO_2 with a high refractive index and low scattering and strong absorption of ultraviolet (UV) radiation. Based on crystal structure as the mediating property, nanotoxicity studies examining the effects of TiO_2 have shown the induction of inflammatory responses, cytotoxicity and reactive oxygen species (ROS) formation. Ferin *et al.* [67] exposed rats to an aerosol of either anatase or rutile by intratracheal instillation in doses of 0.5 or 5.0 mg/rat and determined the TiO_2 retention in the lung up to 132 days post-exposure. They found that both anatase and rutile TiO_2 yielded similar results in lung response such as AM, peroxidase positive AM, and PMN leukocytes. Although both anatase and rutile TiO_2 NPs could be taken up into cells, located in the cytoplasm, and isolated in vacuoles, the cytotoxicity of NPs depends, to some extent, on crystalline structure. Anatase TiO_2 NPs are found to produce greater cell responses and to be more toxic than rutile TiO_2 by MTT and XTT assay [57]. Using the A549 and HDF cell lines, Sayes *et al*. demonstrated that catalytically active anatase was 2 orders of magnitude more cytotoxic (LC_{50} of 3.6 μg/mL) than its similarly sized rutile counterpart (LC_{50} of 550 μg/mL) by determining cell viability and LDH release [58]. The profile and pattern of inflammatory mediator release and temporal induction of oxidative stress were determined using TiO_2 NPs synthesized specifically for toxicological study and a highly relevant human lung cell model, The authors showed that it was a useful approach to delineating the physiochemical properties of nanomaterials in cellular reactivity [63].

The genotoxicity of nanosized anatase (<25 nm), nanosized rutile with SiO_2 coating, and fine rutile (<5 μm) in human BEAS-2B cells was assessed by Falck *et al.* [59]. Nanosized anatase and fine rutile induced DNA damage at the doses of 1 and 10 μg/cm^2, while SiO_2-coated rutile induced DNA damage only at 100 μg/cm^2. Only nanosized anatase could elevate the frequency of micronucleated BEAS-2B

cells. Another study showed a similar result. The anatase nano-TiO_2 caused a stronger induction of DNA damage than rutile in Chinese hamster lung fibroblast (V79) cells as determined by comet assay [60].

In addition, there are several papers about the cytotoxicity of rutile and anatase TiO_2 NPs in other cell lines. Braydich-Stolle *et al.* [61] reported that anatase TiO_2 NPs, regardless of size, could induce cell necrosis, whereas rutile TiO_2 NPs could initiate apoptosis through the formation of ROS. The correlation between crystal phase and oxidant capacity was established using TiO_2 NPs of 11 different crystal phase combinations at similar sizes [68]. The ability of anatase TiO_2 NPs to generate ROS was higher than anatase/rutile mixtures and rutile samples.

2.4. Surface Coating

In commercial applications of TiO_2, surface coating with inorganic or organic substances is often used to facilitate dispersion, solubility, UV protection, wearing and plastics. The toxicity of coated TiO_2 has been evaluated by many researchers, and it is well known that nanomaterial interactions with biology are dictated by the chemical functionalities on the surface in addition to their shape and size. Hydrophobic ultrafine TiO_2 coated with a silane compound was initially reported to be highly toxic and lethal when administrated to rats by intratracheal injection [69]. Since then, the surface coating of TiO_2 with aluminum oxide and/or silica has been shown to produce higher pulmonary inflammation (PMNs in BALF) than the uncoated TiO_2 at 24 h in SD rats administered a large dose of 10 mg/kg [44], but this effect was only a short-term, transient lung inflammatory response and was reversible at one week post-exposure. A similar result was observed with TiO_2 particles having a silane coating (hydrophobic) compared to uncoated TiO_2 (hydrophilic). Rossi *et al.* [45] showed that only SiO_2-coated rutile commercial TiO_2 NPs elicited clear-cut pulmonary neutrophilia, increased expression of tumor necrosis factor (TNF)-α and neutrophil-attracting chemokines both *in vivo* (BALB/c mice, by inhalation at 10 mg/m^3) and *in vitro* (RAW264.7 and human pulmonary fibroblasts MRC-9 cells). They concluded that the level of lung inflammation could not be explained by the surface area of the particles, their primary or agglomerate particle size, or free radical formation capacity but rather by the surface coating. Oberdorster *et al.* reported, however, that 500 μg hydrophobic and silanized ultrafine TiO_2 did not show toxicity, but a much lower pulmonary inflammation was induced in comparison to the hydrophilic uncoated TiO_2 in rat lung [46]. The incorporation of TiO_2 NPs in aged paint matrix blocked most of the particle-induced lung and systemic blood toxicity in BALB/c mice [47]. The rutile TiO_2 NPs coated with alumina (uf-1) and silica/alumina (uf-2) produced transient lung inflammation in rats exposed by intratracheal instillation at doses of 1 or 5 mg/kg, and uncoated anatase/rutile TiO_2 (uf-3) induced cytotoxicity and aggregated macrophages in the alveolar regions of the lung. This occurred because uf-3 particles showed more chemical reactivity than both uf-1 and uf-2 particles [48]. At low doses, surface-coated rutile TiO_2 deposited in the mice lung may potentially perturb several gene expression associated with ion homeostasis and muscle function in the absence of inflammation [27].

The cytotoxicity and genotoxicity of coated and uncoated TiO_2 particles were recently reported using Chinese hamster lung fibroblast (V79) cells [60]. The authors found that both coated and uncoated TiO_2 (anatase and rutile) decreased the cell viability in a mass- and size-dependent manner,

although the TiO_2 NPs coated with polyacrylate were only cytotoxic at high concentration (100 mg/L), and only uncoated nano-TiO_2 induced DNA damage. Rehn *et al.* [49] determined that there was no inflammation or persistent DNA damage in the lung of rats exposed to two types of commercial TiO_2 (untreated with hydrophilic surface and silanized with a hydrophobic surface) at low doses (a single dose of 0.15, 0.3, 0.6 and 1.2 mg) by instillation. Methylated TiO_2 particles induced a lesser inflammatory response (influx of neutrophils and total cell number) in rats after intratracheal instillation in comparison to the untreated TiO_2, and the impact of surface methylation on TiO_2 toxicity was negligible [50]. However, the question remains: what is the underlying mechanism? Thevenot *et al.* tested the cytotoxicity effect of functionalized TiO_2 NPs with various surface groups (–OH, $–NH_2$, and –COOH) and reported that the decreased viability of TiO_2 NPs on lung epithelial cells was associated with TiO_2 particles-induced protein aggregation/denaturation and subsequent impaired cell membrane function [62]. Thus, it can be seen that surface treatment can influence the toxicity of TiO_2 particles in the lung, and the pulmonary toxicity and cytotoxicity of coated TiO_2 NPs might be related to surface chemical activity because of different surface coatings [62].

2.5. ROS Mechanism in Lung Toxicity of TiO_2 NPs

Inhaled TiO_2 NPs show considerably stronger pulmonary inflammatory effects and the mechanism that has been suggested to be involved included ROS production as a hallmark in TiO_2 NP toxicity [2,5,70,71], especially under exposure to light or UV. Sayes *et al.* [58] detected that photoactivated TiO_2 produced greater ROS and resulted in cytotoxicity. This effect is better described by the crystal structure and the specific surface area than mass dose.

Anatase TiO_2 NPs are capable of reacting with a wide range of organic and biological molecules and are more prone to generate ROS than the rutile form. At the cellular level, ROS may be generated directly by particle structures in or near the cell or may arise more indirectly due to the effects of internalized particles on mitochondrial respiration or the depletion of antioxidant species within the cell. In an *in vitro* cell assay, Bhattacharya *et al.* [72] reported that anatase TiO_2 particles with diameters <100 nm were able to generate elevated amounts of free radicals and induced DNA-adduct formation (8-OHdG) but not DNA-breakage after uptake by human lung fibroblasts (IMR-90) and BEAS-2B. The anatase TiO_2 NPs (50, 100, 200 and 300 μg/mL) induced dose-dependent mitochondrial injury and ATP synthesis prevention in A549 cells owing to the over-generation of ROS [73]. The radical generation driven by the surface area of TiO_2 NPs in A549 cells was investigated by Singh *et al.* [74]. They observed that the commercial TiO_2 NPs elicited significant increased ROS generation during cell treatment and indicated that the higher specific surface area of particles caused oxidative stress in A549 cells rather than hydrophobicity [74]. In a rapid cell-free pre-screening assay, Jiang *et al.* [68] investigated the role of crystal structure and surface area on particle ROS generation and established that size, surface area, and crystal structure all contribute to ROS generation. ROS generation was associated with the number of defect sites per surface area, and an S-shaped curve was observed as a function of particle size. The ability of TiO_2 NPs to generate ROS was amorphous > anatase > anatase/rutile mixtures > rutile.

ROS are also produced by lung AM and inflammatory cells during overloading and immunological responses of the lung to inhaled TiO_2 NPs. When antioxidant defenses are overwhelmed, oxidative

stress can occur and is considered an underlying mechanism of the proliferative and genotoxic responses to inhaled TiO_2 NPs. Sun *et al.* [75] investigated that TiO_2 NPs significantly accumulated and increased ROS production (elevated O_2^-, H_2O_2) in mouse lung by intratracheal administration with increasing exposure term. The exposure of human and rodents AM to TiO_2 NPs caused extracellular ROS generation, resulted in increased TNF-α release, heme oxygenase (HO)-1 mRNA and inducible nitric oxide synthase (iNOS) mRNA expression, and induced an increase in the expression of nuclear factor erythroid 2 related factor 2 (Nrf 2) to adapt intracellular responses to TiO_2-induced oxidative stress [45,76–78]. Xia *et al.* [77] concluded that the surface properties of NPs and their interactions with cellular components were capable of generating oxidative stress.

3. Conclusions

Nanoparticles generate great benefits, as well as some potential risks, to human health. Owing to the small size, coupled with the unique physical and chemical properties of NPs, nanotoxicology is put forward by some pioneer scientists to specifically address the problems likely to be caused by nanoparticles/nanomaterials in terms of their potential adverse health effects. In bulk, TiO_2 is considered to be low toxicity and is widely used in many fields. However, at nanoscale, TiO_2 can deposit in the alveolar region and access the lung interstitium after inhalation exposure, eliciting a pulmonary inflammatory response and lung injury.

In this paper, an overview of the lung injury and cytotoxicity of TiO_2 NPs correlated with the physicochemical properties, including size, shape, crystal structure and surface coating is presented. Mass dose is traditionally viewed as the key factor in toxicity studies. However, the biological activity of NPs strongly depends on physicochemical parameters but not on routinely considered in toxicity screening. The unique characteristics of NPs are predominantly associated with their nanoscale structure, size, shape and structure-dependent electronic configurations and an extremely large surface-to-volume ratio relative to bulk materials. The nano size with a high aspect ratio (nanorod, nanobelt, nanofilament) determines the high reactivity of NPs, which enables the insoluble TiO_2 NPs to agglomerate and affect cellular uptake and lung injury. Because of the different crystal lattices, anatase TiO_2 induces greater ROS production and cell responses and is more toxic than rutile due to the active sites on its surface. The coating of TiO_2 with silica and alumina can reduce the pulmonary inflammatory response and cytotoxicity to a certain extent. Lastly, the correlation of ROS production in pulmonary toxicity with properties of TiO_2 NPs was briefly described.

Nanotoxicology and the biological effects of NPs have become hot topics in many fields. When evaluating the potential biological effects of NPs and elucidating their mechanisms for toxicity screening, the size, crystal phase, dispersion and agglomeration status, coating, and chemical composition should be most appropriately characterized.

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Author Contributions

Conception and design: Yubo Fan, Jiangxue Wang; Data collection and analysis: Jiangxue Wang; Drafting of manuscript: Jiangxue Wang; Critical revisions/Supervision: Yubo Fan.

Conflicts of Interest

The authors declare no conflict of interest.

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RESEARCH ARTICLE

Effect of Anatase TiO_2 Nanoparticles on the Growth of RSC-364 Rat Synovial Cell

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Nanoscale materials (such as TiO_2, hydroxyapatite nanoparticles) have gained much concern in the coating of implants for cell adhesion and growth to improve the osteoconductivity. However, due to attrition and corrosion, the wear particles would be generated from the joint in living organism, and influence the physiological function of synovial membranes in joint cavity. In this study, the potential cytotoxicity of anatase TiO_2 nanoparticles (TiO_2 NPs) on rat synovial cell line 364 (RSC-364) was investigated. After treatment with different concentrations of TiO_2 NPs (0, 3, 30, 300 μg/ml), the viability of RSC-364 cells were decreased in a dose-dependent manner. TiO_2 NPs exposure could disrupt the integrity of cell plasma membrane, leading to the increased leakage of lactate dehydrogenase (LDH) into the culture medium. TiO_2 NPs were uptaken by RSC-364 cells. The ultrastructure of RSC-364 cells was changed such as nuclear shrinkage and mitochondrial swelling. The reactive oxygen species (ROS) was over-produced especially in the cells exposed to 30 and 300 μg/ml TiO_2 NPs. The activities of endogeneous antioxidant enzymes, superoxide dismutase (SOD) and catalase (CAT), were significantly decreased. The increased lipid peroxidation product (malondialdehyde, MDA) suggests the oxidative damage in cells. The flow cytometry detected that the cell cycle was blocked in $G0/G1$ phase, inhibiting the cell proliferation. These preliminary results indicate the oxidative stress injury and cytotoxicity of anatase TiO_2 NPs on rat synovial cells. The reasonable and safe application of nanomaterials in artificial implants needs further study.

Keywords: TiO_2 Nanoparticles, Rat Synovial Cells, Reactive Oxygen Species, Oxidative Damage, Cytotoxicity.

1. INTRODUCTION

Based on the American Society for Testing and Materials (ASTM) standard definition, nanoparticles are particles with lengths that range from 1 to 100 nanometers in two or three dimensions.[1] Due to the special properties of nanometric surface topography, high specific surface area, roughness and chemical composition, various nanomaterials are developed for many kinds of applications in industrial, electrical, agricultural, pharmaceutical and medical fields, especially in biomedical products and orthopedic implants.[2,3] It is reported that over 500 consumer products currently on the market contain the elements of nanoscience and nanotechnology.[4] Titanium dioxide nanoparticles (TiO_2 NPs) not only are compatible with the special property of nanomaterials, such as small size, large specific surface area, high surface energy, but also own the characteristic of TiO_2 including excellent photocatalytic activity, corrosion resistance and thermal stability. Nowadays, TiO_2 NPs have been widely used in fields from cosmetics to food packaging, and to biomedical materials. Nanophase coatings (such as TiO_2, hydroxyapatite nanoparticles) on the surface of commercial implants have excellent bioactivity, osteoconductivity and compressive strengths.[5–8] Thus some researchers tend to coat the nanoparticles, such as TiO_2 NPs, Al_2O_3 NPs and ZnO NPs, on the surface of orthopedic implants to improve the osteoconductivity.[5,9–11] In general, TiO_2 is in the amorphous phase or in three crystal phases (rutile, anatase, brookite). These phases of TiO_2 can be found on an implant surface with very different ratios.[8] He et al. reported that the anatase phase of titania with nanometric topography had a better biocompatibility than other crystal phases for osteoblast adhesion, spreading, proliferation and differentiation.[11]

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However, at the bone-implant interface or joint space, nanosized wear particles would be generated from the nanophase implants due to the corrosion, fretting, friction and mechanical loss of prostheses.[12–14] Because of the unique physiochemical properties of nanomaterials, it is so difficult for the immune cell to clean these nanoparticles up completely that they might get into joint periprosthetic tissues (such as synovial membrane),[15] or transfer to other tissues/organs through blood vessel and lymphatic.[16, 17] In our pilot study, Wang et al. simulated this condition by intra-articular injection of TiO_2 NPs and demonstrated that the intra-articular injected anatase TiO_2 NPs had a potential toxicological effect on major organs and knee joints of rats.[17] The intra-articular injected TiO_2 NPs stimulated the inflammatory response and oxidative damage of synovium, and resulted in the synovium hypotrophy. Therefore, in this study, the aim is to evaluate the cytotoxicity of TiO_2 NPs. In order to determine the cytotoxicity on joint periprosthetic cells, the rat synovial cell line RSC-364 is selected. Cell viability, cellular uptake of TiO_2 NPs, level of reactive oxygen species (ROS) and intracellular oxidative response, and the cell cycle distribution are investigated.

2. EXPERIMENTAL DETAILS

2.1. Materials

The commercially pure anatase TiO_2 nanoparticles (Wan Jing New Material Co., Ltd., purity $>99.8\%$) without any coating were used in this study. The properties such as shape, size, surface area, and structure state of TiO_2 were well characterized previously.[17] In brief, TiO_2 NPs are red blood cells-like wafers with the average diameter of 45.87 ± 7.75 nm, the thickness of 10–15 nm, and the average pore size of 7.50 ± 2.58 nm. The specific surface area is 105.03 m^2/g with the cumulative pore volume of 0.42 cm^3/g. TiO_2 NPs are aggregated in physiological solution, and the aggregated diameter of TiO_2 NPs is from 183.7 to 282.0 nm and from 575.6 to 1018.9 nm. High-sugar Dulbecco's modified Eagle's medium (DMEM) were purchased from GIBCO Invitrogen (USA). Fetal bovine serum (FBS) was purchased from MDgenics (New Zealand). Penicillin G and Streptomycin were purchased from INALCO (USA). Trypsin was purchased from AMRESCO (USA). Lactate dehydrogenase (LDH) assay kit was obtained from Nanjing Jiancheng Bioengineering Institute (Jiangsu, China). Cell counting kit-8 (CCK-8), 2,7-dichlorodihydrofluorescein diacetate (DCFH-DA) assay kit, lipid peroxidation product (malondialdehyde, MDA) assay kit, cell lysis buffer, and BCA protein assay kit were all obtained from Beyotime Institute of Biotechnology (Jiangsu, China). Propidium iodide (PI) was obtained from Peking University Health Science Center. Phenylmethanesulfonyl fluoride (PMSF) was provided by Roche Co. Ltd.

2.2. Cell Culture and Nanoparticle Suspensions Preparation

Rat synovial cell line (RSC-364) was obtained from the Orthopaedics Insititute of the 301 Hospital (Beijing, China). The cells were cultured in DMEM with 10% FBS, 100 U/mL penicillin, and 100 μg/ml streptomycin at 37 °C in a 5% CO_2 humidified environment. For the CCK-8 assay, the cells were seeded in 96-well plates at a density of 4.0×10^3 cells per well in 200 μl culture medium. For the other analyses, the cells were seeded in 6-well plates at a density of 8.0×10^5 cells per well in 2 ml of culture medium. All cells were exposed to TiO_2 NPs suspensions after 70% confluence.

TiO_2 NPs were freshly dispersed in the cell culture medium and diluted to appropriate concentrations (3, 30, and 300 μg/ml). To avoid aggregation, the suspensions were ultrasonicated for 30 min in sealed sterile tubes. Before being added to the cell culture, 10% FBS was added in the suspensions. RSC-364 cells were cultured in media containing different concentrations of TiO_2 NPs. Culture media without TiO_2 NPs served as the control in each experiment.

2.3. CCK-8 Assay

This assay assumes that the relative number of living cells is linear with the metabolic activity indicated by mitochondrial dehydrogenases reduction of WST-8 to produce a water-soluble formazan product.[18] RSC-364 cells were exposed to 0, 3, 30 and 300 μg/ml TiO_2 NPs for 6 h or 12 h. Then, cells were washed with PBS for 2 times, and incubated with 100 μl DMEM medium and 10 μl CCK-8 at 37 °C for 2 h. The intensity was measured using a microplate reader for enzyme-linked immunosorbent assay with an absorption wavelength of 450 nm. Cell viability was expressed as the percentage of viable cells relative to control. All experiments were performed at least in triplicate.

2.4. LDH Leakage

LDH is an enzyme widely present in cytosol. When plasma membrane integrity is disrupted, LDH leaks into culture media and its extracellular level is elevated. To assess the possible impairment of RSC-364 cell membranes caused by TiO_2 NPs, LDH activity in the culture medium was assessed using an LDH assay kit, which is based on measuring the enzyme-coupled reduction of NAD^+ at 340 nm. Briefly, RSC-364 cells were incubated with serum-free DMEM containing 0, 3, 30 and 300 μg/ml TiO_2 NPs for 12 h. The medium was then collected and centrifuged at 10,000 g in 4 °C for 10 min. The supernatant was analyzed for LDH activity as recommended by the manufacture.

2.5. Determination of ROS Production

The production of ROS was determined using the fluorescence probe DCFH-DA. After treating with the above mentioned TiO_2 NPs suspensions for 12 h, RSC-364 cells were incubated with 10 μM DCFH-DA in the dark for 30 min at 37 °C. After treatment, cells were collected by trypsinization, centrifuged at 1,000 rpm for 5 min and washed three times with physiological buffered saline solution (PBS). The oxidation of DCFH by ROS yields a highly fluorescent compound, 2′,7′-dichlorofluorescein (DCF), which can be analyzed by flow cytometry (BD FACS Calibur). The mean of DCF fluorescence intensity was obtained from 20,000 cells in each experimental group using 488 nm excitation and 530 nm emission settings.

2.6. Biochemical Parameters Assays

After exposure to TiO_2 NPs suspensions for 12 h, RSC-364 cells were washed with PBS for 2 times, lysed by cell lysis buffer. The homogenization was centrifuged at 14,000 g for 10 min in 4 °C (Universal 32R, Hettich zentrifugen, Germany), collecting the supernatant to analyze some oxidative biomarkers including the activity of SOD, CAT, and lipid peroxidation. CAT activity was determined by measuring the red product *N*-(4-antipyryl)-3-chloro-5-sulfonate-*p*-benzoquinonemonoimine according to the decomposition of hydrogen peroxide by catalase in an exact time (Beyotime Institute of Biotechnology, Jiangsu, China). SOD activity was assayed according to WST-1 (2-(4-Iodophenyl)-3-(4-nitrophenyl)-5-(2,4-disulfophenyl)-2H-tetrazolium, monosodium salt) method (Beyotime Institute of Biotechnology, Jiangsu, China). Superoxide anion-free radicals produced by xanthine/xanthine oxidase system can oxidize WST-1 into the soluble formazan. Superoxide dismutase has the ability to specifically inhibit free radicals of superoxide anions and control the amount of formazan. The lipid peroxidation product was measured using the thiobarbituric acid (TBA) assay for MDA content. The protein concentration was determined according to the BCA method.

2.7. Cell Cycle Assays

RSC-364 cells treated with or without TiO_2 NPs were washed with PBS and trypsinized from each experimental group. Cells were fixed using a solution containing 75% ethanol in PBS at 4 °C overnight. Then, the cells were centrifuged at 1,000 rpm for 5 min to remove the fixation solution. The cell pellets were collected and incubated with PBS containing 20 μg/ml RNase (DNA staining solution) at 37 °C for 30 min. After centrifugation, the cells were stained with PI for 1–2 min in the dark and 20,000 cells per group were analyzed by flow cytometry (BD FACS Calibur).

2.8. Transmission Electron Microscopy (TEM)

For TEM study, RSC-364 cells treated with or without TiO_2 NPs were collected by cell scraper, immediately immersed in 2.5% glutaraldehyde at 4 °C overnight. After washing with PBS sufficiently, samples were fixed with 1% osmium tetroxide, dehydrated in a graded series of ethanol, and embedded in araldite, polymerized for 24 h at 37 °C. The ultra thin sections (60 nm) were cut, stained with uranyl acetate and lead citrate, and then observed with TEM (HITACHI H-600, Japan) at 50 kV.

2.9. Statistical Analysis

All data are reported as the mean ± standard deviation (SD) and analyzed using the SPSS 13.0 (SPSS Inc., Chicago, IL, USA). Statistical analysis was performed for the experimental data using one-way analysis of variance (ANOVA). Results with $p < 0.05$ are considered to be statistically significant.

3. RESULTS AND DISCUSSION

3.1. Cytotoxicity of TiO_2 Nanoparticles on RSC-364

Owing to the special property of nanoparticles, the cytotoxic effect of TiO_2 NPs on various mammalian cell lines was evidenced and summarized.[19–21] In this study, to investigate the influence of TiO_2 NPs on RSC-364 cells viability, firstly, different concentration of TiO_2 NPs (0, 3, 30, and 300 μg/ml) was selected to treat RSC-364 cells for 6 h or 12 h. CCK-8 assay was used to characterize the cells viability. As shown in Figure 1, after exposure to TiO_2 NPs, the viability of RSC-364 cells was decreased, especially the cells exposed to 30 μg/ml and 300 μg/ml TiO_2 NPs. Compared with the control, the viability of

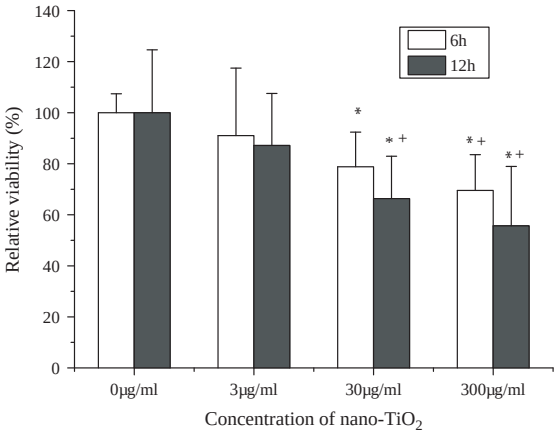

Fig. 1. Cell proliferation of RSC-364 cells after exposure to TiO_2 NPs for 6 h or 12 h. Significance indicated by: $^*p < 0.05$ versus the control; $^+p < 0.05$ versus the 3 μg/ml group.

cells in the 30 μg/ml and 300 μg/ml groups decreased by 21.17% and 30.43% after 6 h exposure, respectively. For 12 h exposure, the decrease was up to 33.66% and 44.33%, respectively, which was statistically significant from the control and the 3 μg/ml groups. This indicated that TiO_2 NPs inhibited RSC-364 cells proliferation in a dose-dependent relationship. The significant decrease of cells viability occurred at 12 h exposure. Therefore, the cytotoxicity of TiO_2 NPs on RSC-364 was analyzed at 12 h exposure.

LDH is a soluble cytosolic enzyme present in most eukaryotic cells, where its main function is to catalyze the oxidation of L-lactate to pyruvate. When the cell is injured, the permeability of cell membrane increases, which results in LDH releasing into cell culture medium.[22] By determining LDH activity in culture medium, the cell injury induced by TiO_2 NPs could be estimated (Fig. 2). In RSC-364 cells culture medium, LDH activity increased with TiO_2 NPs concentration. It was notable that LDH activity in the 30 and 300 μg/ml groups was significantly higher ($p < 0.05$) than that in the control. Compared with the control, the increase level of 213% and 253% was detected for LDH activity in the 30 μg/ml and 300 μg/ml groups, respectively. In addition, there was a statistically significant difference between the 3 μg/ml and 300 μg/ml groups, where the LDH activity in the 300 μg/ml group showed 1.11 times higher than that in the 3 μg/ml group. These results demonstrated that RSC-364 cells plasma were damaged severely by TiO_2 NPs, especially at the highest concentration.

3.2. Oxidative Stress

The generation of ROS following 12 h exposure to TiO_2 NPs at the concentration of 0, 3, 30 and 300 μg/ml is shown in Figure 3. We observed that ROS level was low

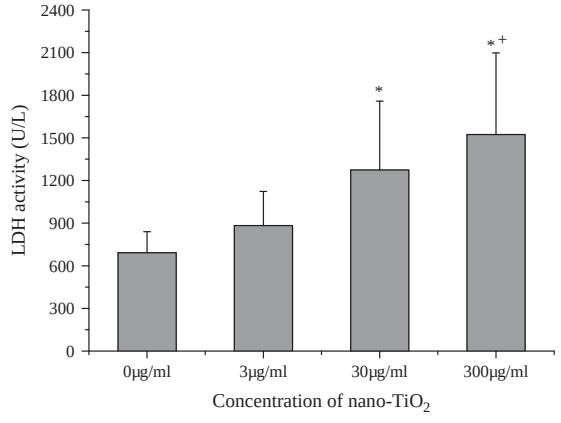

Fig. 2. LDH activity in RSC-364 cells culture medium after exposure to TiO_2 NPs. Significance indicated by: $^*p < 0.05$ versus the control; $^+p < 0.05$ versus the 3 μg/ml group.

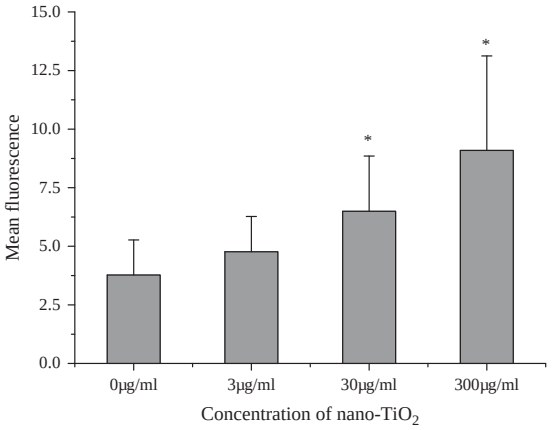

Fig. 3. Level of ROS in RSC-364 cells after incubating with TiO_2 NPs. Significance indicated by: $^*p < 0.05$ versus the control.

in normal cells. With the TiO_2 NPs concentration increase, the level of ROS increased in a concentration-dependent manner. In the 30 and 300 μg/ml groups, ROS levels were significant higher than the control ($p < 0.05$). As RSC-364 cells exposure to 300 μg/ml TiO_2 NPs, ROS level was upregulated by 1.41 times higher than the control. This result demonstrated the overproduction of ROS, which was consistent with the reported data.[23]

Further, the activities of SOD, CAT, and MDA content were determined to evaluate the level of oxidative stress response in RSC-364 cells after exposure to TiO_2 NPs. SOD and CAT are important endogenous antioxidative enzymes for their reducing H_2O_2 and superoxide anion radicals, protecting polyunsaturated fatty acid (PUFA) from lipid peroxidation, and further preserving the intact structure of cell membrane. As shown in Figure 4, SOD activity in RSC-364 cells exposed to 30 and 300 μg/ml TiO_2 NPs was significantly lower ($p < 0.05$) than that in the control. CAT activity was also decreased in every exposed group. In the 300 μg/ml group, CAT activity was significantly different from that in the control and the 3 μg/ml groups (Fig. 5). This meant the endogenous antioxidant could not decompose the produced ROS. The oxidation-antioxidant balance system in cells was disrupted by the over-produced ROS. MDA content, lipid peroxidation product, was highly elevated in RSC-364 cells after exposure to 30 and 300 μg/ml TiO_2 NPs. There were 2.84 and 4.57 times ($p < 0.05$) higher than the control, respectively (Fig. 4). Based on this, we concluded that ROS including H_2O_2 and superoxide anion radicals was produced in RSC-364 cells by incubating with TiO_2 NPs. The balance of endogenous oxidation–reduction system was broken. The cells lose the antioxidative ability, resulting in the oxidative damage (MDA elevation). However, it was noteworthy that this was in a dose-dependent manner.

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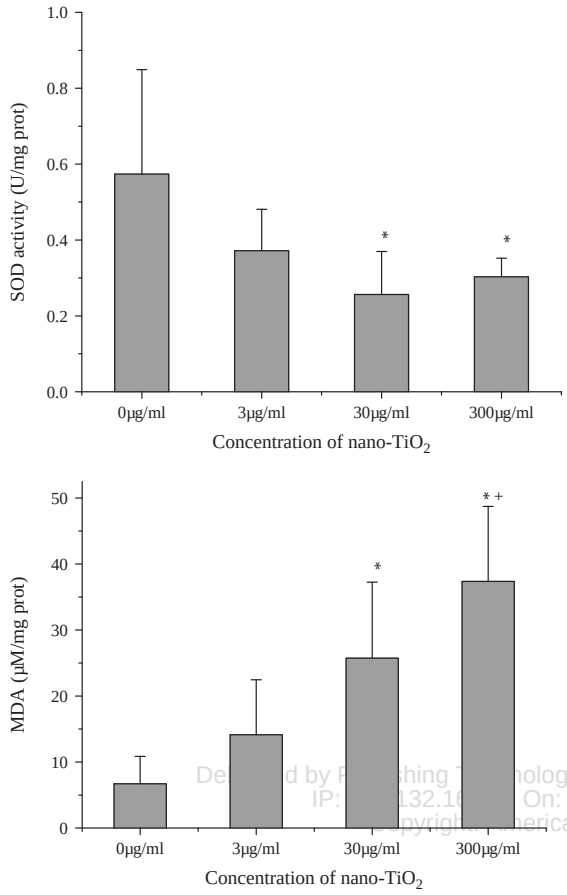

Fig. 4. Levels of SOD and MDA in RSC-364 cells after exposure to TiO_2 NPs. Significance indicated by: $^*p < 0.05$ versus the control; $^+p < 0.05$ versus the 3 μg/ml group.

3.3. Cell Cycle

Oxidative stress in TiO_2-NPs treated RSC-364 cells indicates the possibility of DNA damage. The early effect of DNA damage will be evidenced in cell cycle progression. Thus the cell cycle analysis for RSC-364 was measured using flow cytometry. The result was shown in Table I. After exposure to TiO_2 NPs for 12 h, there were a block of cell cycle transition in gap 1 ($G0/G1$) phase. By exposure to 30 and 300 μg/ml TiO_2 NPs, cells in gap2/mitosis ($G2/M$) phase were obvious decreased. Especially by treated with 300 μg/ml TiO_2 NPs, cells arrested in $G0/G1$ phase (84.00%), only 0.40% cells in G2/M phase, which was significantly different ($p < 0.05$) from the control and the 3 μg/ml groups. TiO_2 NPs exposure blocked the cells in $G0/G1$ phase, inhibited the DNA synthesis and cell proliferation. This would result in the decrease of cell viability, which was consistent with the result of CCK-8 assay. Additionally, Ishikawa et al. reported that cells with irreversible DNA damage would give rise to accumulation in $G1$ phase.[24] Therefore, DNA damage would be induced in RSC-364 cells by nanoparticles exposure at specific dose, which need to be evaluated further.

Table I. Cell cycle distribution of RSC-364 cells after exposure to TiO_2 NPs.

Groups (μg/ml)	$G0/G1$ phase (% of cells)	S phase (% of cells)	$G2/M$ phase (% of cells)
0	72.61 ± 9.19	19.18 ± 7.24	8.21 ± 2.67
3	74.40 ± 8.02	17.19 ± 4.9	8.35 ± 3.35
30	76.57 ± 7.35	17.12 ± 4.93	6.31 ± 2.66
300	84.00 ± 3.17*	15.60 ± 3.37	0.40 ± 0.55*

Notes: $^*p < 0.05$ versus the control; $^+p < 0.05$ versus the 3 μg/ml group.

3.4. Cellular Uptake of TiO_2 NPs

To further analyze the cytotoxic effect of TiO_2 NPs, the cellular uptake of TiO_2 NPs was assayed by TEM (Fig. 6). In the TiO_2-exposed groups, the aggregates of TiO_2 NPs were internalized by cells in this form, entered into vesicle and get into mitochondria. The internalization of TiO_2 NPs caused the ultrastructural change of RSC-364. After exposure to 3 μg/ml TiO_2 NPs, the nuclear shrinkage was observed and the chromatin was condensed and distributed over the fringe of nucleus. The mitochondria were swelling (Fig. 6(B)). In the cells exposed to 30 μg/ml TiO_2 NPs, the nuclear fragmentation was observed (Fig. 6(C)). The cell disintegration and the apoptosis body were appeared, which meant that the late apoptosis occurred in the cells exposed to 300 μg/ml TiO_2 NPs (Fig. 6(D)). These indicated that TiO_2 NPs exposure could induce the ultrastructural change of RSC-364 cells at the subcellular level.

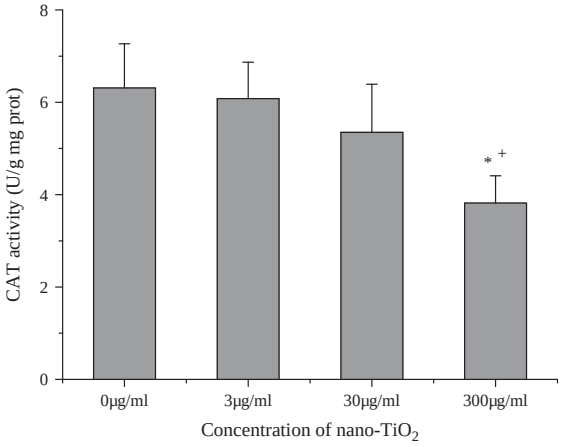

Fig. 5. Levels of CAT activity in RSC-364 cells after exposure to TiO_2 NPs. Significance indicated by: $^*p < 0.05$ versus the control; $^+p < 0.05$ versus the 3 μg/ml group.

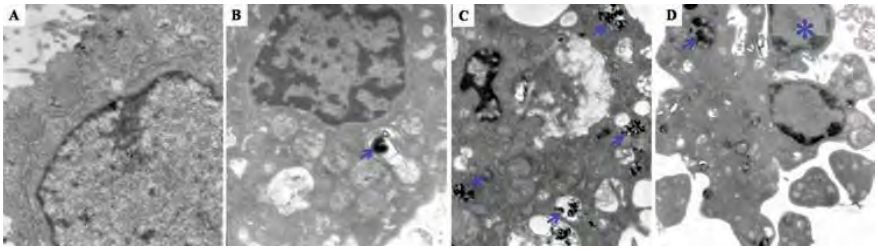

Fig. 6. Electric micrographs of RSC-364 cells after exposure to TiO_2 NPs. (A) Cells in DMEM standard medium without exposure to TiO_2 NPs–negative control (B) cells exposure to TiO_2 NPs at the concentration of 3 μg/ml. The swelling mitochondria were observed. (C) Cells exposure to TiO_2 NPs at the concentration of 30 μg/ml. (D) Cells exposure to TiO_2 NPs at the concentration of 300 μg/ml. The nuclear fragmentation was observed. TiO_2 NPs formed aggrecates and were uptaken by RSC-364 cells. Arrows indicate the internalized TiO_2 NPs in cells. Asterisk indicates the apoptotic body.

4. CONCLUSION

In summary, the influence of anatase TiO_2 NPs on cell growth is characterized. Results demonstrate that anatase TiO_2 NPs exposure can increase the permeability of RSC-364 cells membrane, leading to the increased LDH activity in culture medium. TiO_2 NPs are uptaken by RSC-364 cells. The ultrastructural change of RSC-364 cells is evidenced by TEM. The flow cytometry detected the over-production of intracellular ROS in the TiO_2 NPs-exposed synovial cells. The main antioxidant enzymes SOD and CAT activities decrease in the cells after exposure to 30 μg/ml and 300 μg/ml TiO_2 NPs. These imply that the oxidation-antioxidant system is imbalanced in RSC-364 cells after treating with TiO_2 NPs. The oxidative stress response is induced. The elevated MDA level suggests the oxidative damage occurred in cells. The cell cycle is blocked in $G0/G1$ phase, inhibiting the cell proliferation, and finally the cell viability decreases. What's more, the effect of anatase TiO_2 NPs on RSC-364 cells viability is in a dose-dependent relationship. This work provides the basic cell biological response of RSC-364 to anatase-TiO_2 NPs, which are imperative to understand for their predicted applications in biomedical science and orthopaedic materials. This information is highly important in the risk assessment of TiO_2 NPs.

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Research Article

Evaluation on Cartilage Morphology after Intra-Articular Injection of Titanium Dioxide Nanoparticles in Rats

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Nanoscale wear particles would generate from orthopedic implants with nanoscale surface topography because of residual stress. In this study, the effect of TiO_2 nanoparticles on articular cartilage was investigated by intra-articular injection in rats. Using contrast-enhanced high-resolution microcomputed tomography (micro-CT) technology, the decreased thickness of articular cartilage in distal femur was determined at 1, 7, 14, and 30 days after nanoparticle exposure. A strong linear correlation ($r = 0.928$, $P < 0.0001$) was observed with the results obtained by needle probe testing. After exposure to TiO_2 nanoparticles, cartilage thickness showed time-dependent decrease, and cartilage volume was decreased too. Further, the histopathological examination showed the edema chondrocyte and shrinked nucleus in the radial and calcified zone of cartilage. The ultrastructure of articular cartilage implied that the chondrocyte was degenerated, expressing as the condensed chromatin, the dilated endoplasmic reticulum, and the rich mitochondria. Even, the fragments of ruptured endoplasmic reticulum were observed in the cytoplasm of chondrocytes at postexposure day 30. Results indicate that potential damage of articular cartilage was induced by particles existed in knee joint and imply that the biomonitoring should be strengthened in patients with prostheses replacement.

1. Introduction

The nanoscale (less than 100 nm) surface topography endows nanomaterials as high biological active matrix for protein adsorption and focal attachment [1, 2], which provides a forthcoming prospect in tissue regeneration and orthopedic prostheses [3–5]. Titanium is widely used in hip and joint implants and is biocompatible because it spontaneously forms a protective oxide thin film (TiO_2 coating, typically 4–6 nm thin) at its surface. It is reported that nanoscale coating creates a conditioned interface for osteoblast and chondrocyte adhesion [6–10] and promotes the osteointegration and bone mineralization *in vivo* [11]. However, because of corrosion, fretting, friction, and mechanical loss, many wear particles would generate at the bone-implant interface or in the joint space [12, 13]. Kuster et al. [14] reported that wear particles with lamellar, chunky, osseous, elongated, and rod shapes were observed in healthy and osteoarthritic human knee joints. Except the different shapes, the nanoscale polyethylene wear particles below 0.05 μm and metal wear particles with sizes from 40 to 120 nm containing Co, Cr, and Ti are detected *in vivo* with high-resolution microscopy technology [15, 16]. Many researchers reported that nanoscale particles have a potential impact on living organism [17, 18]. *In vivo*, TiO_2 nanoparticles would be phagocytosed by the epithelial and endothelial cells or macrophages, be translocated into the heart, lung and liver tissues with the blood circulation and cause the oxidative stress and inflammatory response [19, 20]. For the interaction with cells, TiO_2 nanoparticles are generally studied *in vitro* that the DNA damage and cell membrane decomposition are induced by the photocatalysis of TiO_2 [21–23]. In our pilot study, the intra-articular-injected TiO_2 nanoparticles have a potential toxicological effect on the knee joint and could be disseminated to the major organs of rats from joint cavity [24]. The aggregated TiO_2 nanoparticles deposited in the

knee joint induce the synovium hypertrophy, lymphocytes and plasma cells infiltration, fibroblast proliferation, and oxidative damage. However, some studies reported that the inflammatory response occurred in synovium involved in regulating the remodeling of articular cartilage, leading to a loss of cartilage [25, 26].

Articular cartilage is very important in the joint movement for providing a resilient and low-friction bearing surface. The thickness of articular cartilage is related either to the age, to the osteoarthritis, or to the mass of donors. Shepherd and Seedhom [27] reported that thick cartilage existed in the incongruent knee joint where most body weight loaded on. Generally, the cartilage thickness is measured by needle probe, ultrasonic technique, optical stereomicroscope, and magnetic resonance imaging (MRI) technique [28]. MRI technique is successfully used for measuring the articular cartilage thickness of humans [29], but the resolution of current clinical MRI systems (200 μm) is not enough to analyze the small animal models and limits its application. With the needle probe method, the intact, in situ cartilage can be tested.

X-ray microcomputed tomography (μ-CT) is an X-ray-based nondestructive 3D imaging modality with micrometer-level voxel resolutions and quantitative morphological analysis of electron-dense tissues such as tooth and bone of rat, mouse, and rabbit. It is widely used for diagnosing disease in medicine and scientific research in material science, pharmacy, and biology, and so forth. Golding et al. [30] proved that μ-CT is a faster and more accurate spatially 3D technique than histological sections for reconstruction of molluscan anatomy. For soft tissues, the contrast-enhanced technique with iodic-contained solution agent is developed to compensate poor radiopacity and to improve the X-ray images. The successful measurement of kidney volume, length, and thickness in mice was performed *in vivo* and *ex vivo* by Almajdub et al. [31] using the contrast-enhanced high-resolution μ-CT technology as well as the liver and spleen tumor assessment in living mice [32]. Recently, the equilibrium partitioning of an ionic contrast agent via μ-CT (EPIC-μCT) is presented as a noninvasive imaging technique and used to assess the articular cartilage morphology in rabbit [33] and rat model [34].

In this study, the potential influence of intra-articular injected TiO_2 nanoparticles on the articular cartilage in distal femur of rats are investigated at postexposure days 1, 7, 14, and 30. The general approach is to expose rats to the well-characterized nanoparticles by intra-articular injection, to estimate the cartilage thickness and volume with time course using 3D cartilage model which was reconstructed by contrast-enhanced high-resolution μ-CT technology and to assess the potential cartilage injury by morphology analysis.

2. Material and Methods

2.1. Materials. TiO_2 nanomaterials (Hangzhou Wan Jing New Material Co., Ltd.) without any coating were used in this study. Its purity was higher than 99.8%. The properties such as size, crystal profile, and structure state of TiO_2 were well characterized previously [24]. Briefly, TiO_2 nanoparticles were red blood cells-like wafers with the average diameter of 45.87 ± 7.75 nm, the thickness of 10~15 nm, and the average pore size of 7.50 ± 2.58 nm. The crystal profile was pure anatase. The surface area was 105.03 m^2/g with the cumulative pore volume of 0.42 cm^3/g, which was determined under Quadrasorb SI analyzer (Quantachrome Instruments, USA) by N_2 absorption at 77.3 K. In sterile physiological solution, TiO_2 tended to aggregate and clustered from 183.7 to 282.0 nm and from 575.6 to 1018.9 nm.

The contrast agent used in this study was Compound Meglumine Diatrizoate Injection (CMDI, ionic monomer iodic contrast agent, iodine concentration = 370 mg/mL; Shanghai Xudong Haipu Pharmaceutical Co., Ltd, Shanghai) consisting of 32 mg/mL sodium diatrizoate and 268 mg/mL meglumine diatrizoate. The ultrapure water was prepared with a resistivity of 18.2 MΩ*cm (PureLab Plus, Pall, USA). Phenylmethanesulfonyl fluoride (PMSF) was provided by Roche. All other reagents used in this study were at least of analytical grade.

2.2. Animals. Male Sprague Dawley rats with 180–200 g body weight (about 7-8 weeks old, Experimental animal center of Peking University) were housed in polycarbonate cages placed in a ventilated, temperature-controlled room. The standard conditions were supplied and maintained at 20 ± 2°C room temperature, 60 ± 10% relative humidity, and 12 h light/dark cycle. The commercial pellet diet and distilled water for rats were available *ad libitum*. All procedures used in these animal studies were compliant with the local approved protocols of the Administration Office Committee of Laboratory Animal. Animals were acclimated to this environment for five days prior to treatment.

2.3. Experimental Protocol. We prepared TiO_2 suspension using physiological saline solution at 2 mg/mL. Briefly, the powdered TiO_2 nanoparticles were dispersed in the fresh sterilized physiological saline solution, and the suspension was ultrasonicated for 10 min in 4°C at 200 W to disperse completely as much as possible.

The animals' experiments were set at four time intervals (postexposure days 1, 7, 14, and 30) to evaluate the change of articular cartilage thickness and morphology. Based on our previous study [24], both control and nanoparticles-exposed rats were included (10 rats per group) in each time interval because the intra-articular nanoparticles would be disseminated to other tissues. The dosage of 2 mg/kg was selected, which is lower than the detected Ti particles in patients [35]. Before treatment, animals were anesthetized by 30 mg/kg bw i.p. sodium pentobarbital (Germany). The furs on bilateral hind knees were shaved softly after soaking with soaps liquid, and the povidone iodine was applied to prevent infection. The two hind knee joints were intra-articular injected with 100 μL of 2 mg/mL TiO_2 suspensions every other day for 4 times, respectively. TiO_2 suspension was vortexed for 3 min before injections. The equal volume physiological saline solution was given to the control rats. Following the exposure, all rats were held for drink and food *ad libitum*. The daily activity and body weight of all rats were recorded carefully. At postexposure days 1, 7, 14,

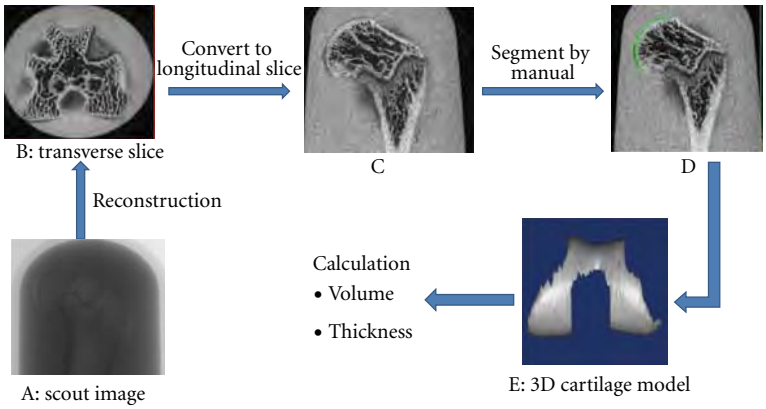

Figure 1: Scanning, segmenting, and remodeling of articular cartilage in distal femur. (A): scout image of distal femur obtained by μ-CT; (B): transverse slice of distal femur; (C): sagittal slice of distal femur; (D): the green part is cartilage; E: 3D cartilage model.

and 30, the hind knee joints were collected both in the control and exposed group. To cut off the peripheral muscle and ligament carefully, six distal femurs from three rats per group were fixed in 10% formalin solution for histopathological analysis. Three fresh cartilages from three rats per group were immediately immersed in 2.5% glutaraldehyde at 4°C for transmission electron microscopy observation. The remainder distal femurs were cut transversely at the midpoint of the femoral neck, wrapped in sterilized gauze which was soaked with phosphate buffered saline (PBS), and then stored in −20°C. To protect the cartilage from degeneration, 0.1 mmol/L PMSF was used in PBS.

2.4. Determination of Contrast Agent Concentration. The concentration of contrast agent is very important for distinguishing the cartilage and calcified bone tissue, segmenting the cartilage contour accurately, and remodeling the cartilage. To determining the optimal contrast agent concentration, the contrast agent CMDI was diluted in different concentration by PBS solution. The four distal femurs from 10-week-old rats additionally was incubated in 5 mL tube containing 20%, 30%, and 40% CMDI dilution of PBS for 10 min at 37°C, then immediately transferred to a μ-CT system for scanning, respectively. All scanning were carried out at 70 kV, 142 μA, and with 18 μm isotropic pixel size.

2.5. Cartilage Scanning and Remodeling. Based on the above determined contrast agent concentration, the incubation in 30% CMDI for 10 min at 37°C was selected as the best protocol. The freezed distal femurs were thawed at 37°C, incubated in 30% CMDI for 10 min, and then scanned with 18 μm isotropic pixel size using SkyScan 1076 microtomograph (Aartselaar, Belgium) at 70 kV, 142 μA. The whole procedure of scanning, segmenting, and remodeling of articular cartilage was shown in Figure 1. The specimen tube was fixed on object bed at horizontal level. After preview, the 35 × 200 mm area was scanned with the source-detector pair rotating with 0.02°/min/step. To enhance tissue features in image, aluminum 1.0 mm physical filter was selected to absorb the low-energy X-ray. The transverse slices of distal femur were reconstructed using cone-beam reconstruction program and transformed to sagittal slices using DataViewer software package (Aartselaar, Belgium). In order to accurately partition the contrast agent, articular cartilage, and calcified bone, the cartilage contour was segmented by manual according to the CT value. Finally, the 3D cartilage model was reconstructed (Figure 1(e)). The 3D cartilage model was imported into the 3D software Geomagic Studio (Raindrop Geomagic Inc., USA) and to calculate the volume of articular cartilage. Because the change of articular cartilage thickness occurred at the femoral weight bearing sites [33], the cartilage thickness was determined at six points on the superior load-bearing aspect of the medial condyle and lateral condyle of femur by virtually sectioning 3D cartilage model at the desired sagittal plane. All scans and analyses were performed by a single-experienced operator.

2.6. Needle Probe Testing. The distal femurs used in μ-CT scanning were potted in dental resin using a cylindrical pot and then used to measure cartilage thickness by needle probe testing. The potted specimen was mounted on a specially designed apparatus that could adjust the articular cartilage surface precisely in five degree-of-freedom directions (x, y, θx, θy, and θz) to perpendicular to the needle probe (Figure 2(a)). The apparatus was positioned on the base groove of an Autograph AG-IS material testing machine (Shimadzu, Japan). Once positioned, the assembly was locked strictly to provide enough rigidity through the tests.

Articular cartilage thickness was measured by slow (0.03 mm/min) insertion of a blunt needle probe (0.5 mm in diameter) attached to a 50 N load sensor (sensitivity: 0.25 N). All tests were conducted at room temperature. In whole test procedure, the cartilage surface was kept hydrated with PBS-containing PMSF. The load and displacement outputs were recorded at 0.05 sec interval as the probe penetrated into the cartilage tissue. A change of the slope of the load-displacement curve indicated the probe penetrated from the cartilage to the calcified bone. Cartilage thickness was measured using the probe to sense the moments when the

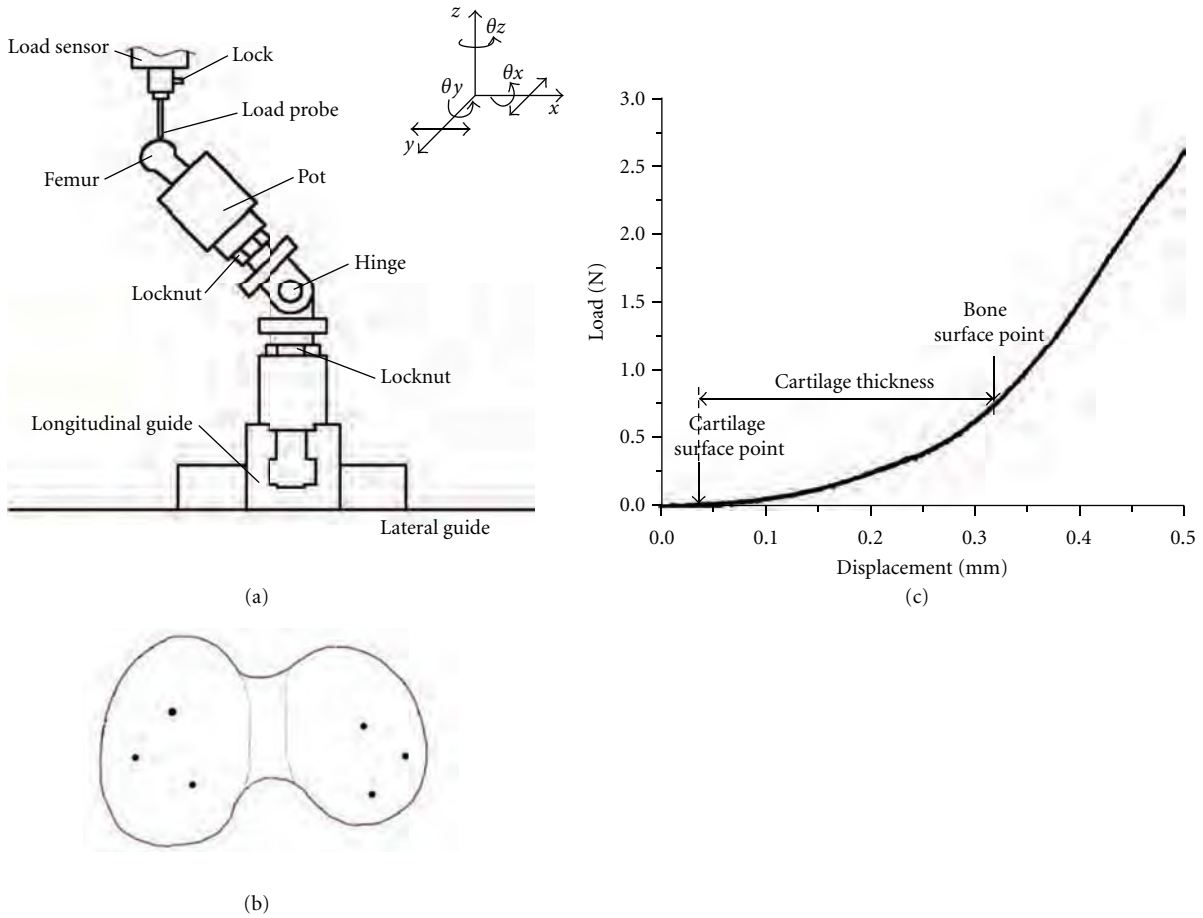

Figure 2: (a) the sketch of specially designed apparatus with five degree-of-freedom direction, (x, y, θx, θy, and θz) adjustment of articular cartilage surface perpendicular to the load probe (b) the six points on the superior load bearing aspect of the medial condyle and lateral condyle of distal femur, which is subjected to needle probe tests (c) the representative load-displacement curve.

probe pressed the articular surface and when it contacted the calcified bone (Figure 2(c)). Needle probe testing was performed at six points on the medial condyle and lateral condyle of femur (Figure 2(b)) in corresponding to the sites on 3D cartilage model.

2.7. Histopathology Examination of Articular Cartilage. The distal femurs were fixed in 10% formalin solution, decalcified with 10% nitric acid for 24 h, and rinsed by tap water for 4 h. And then, the histopathological tests were performed using standard laboratory procedures. Briefly, the tissues were dehydrated in graded series of 80%, 90%, 95%, and 100% ethanol, followed by clearing in toluene, infiltrated in hot liquid paraffin, finally embedded in paraffin blocks to allow for 5 μm sections, and mounted onto the glass slides. They were stained with hematoxylin-eosin (H&E) for microscopic analysis. All sections were observed, and the photos were taken using optical microscope (Olympus BX51, USA). The identity and analysis of pathology sections were blind to the pathologist.

2.8. Ultrastructure of Cartilage by Transmission Electron Microscopy. The fresh cartilage was carefully cut off by scalpel and immediately immersed in 2.5% glutaraldehyde at 4°C. After washing with PBS sufficiently, the cartilage was fixed with 1% osmium tetroxide, dehydrated in a graded series of ethanol, embedded in araldite, and polymerized for 24 h at 37°C. Ultrathin sections (50 nm) were cut with ultramicrotome (LKB-V, Sweden), contrasted with uranyl acetate and lead citrate, and observed with TEM (H-600, Hitachi).

2.9. Statistical Analysis. For statistical analysis, all data are expressed as mean ± standard deviation (SD). The one-way analysis of variance (ANOVA) was performed to analyze the significance using the statistical software SPSS 13.0 for windows. A LSD post hoc multiple comparison test was used for different groups. $P < 0.05$ was considered as the statistical significance.

3. Results

3.1. Concentration of Contrast Agent. According to the different X-ray attenuation (CT value) of contrast agent, cartilage and calcified bone, the optimal contrast agent concentration was determined. Figure 3 showed the representative saggittal

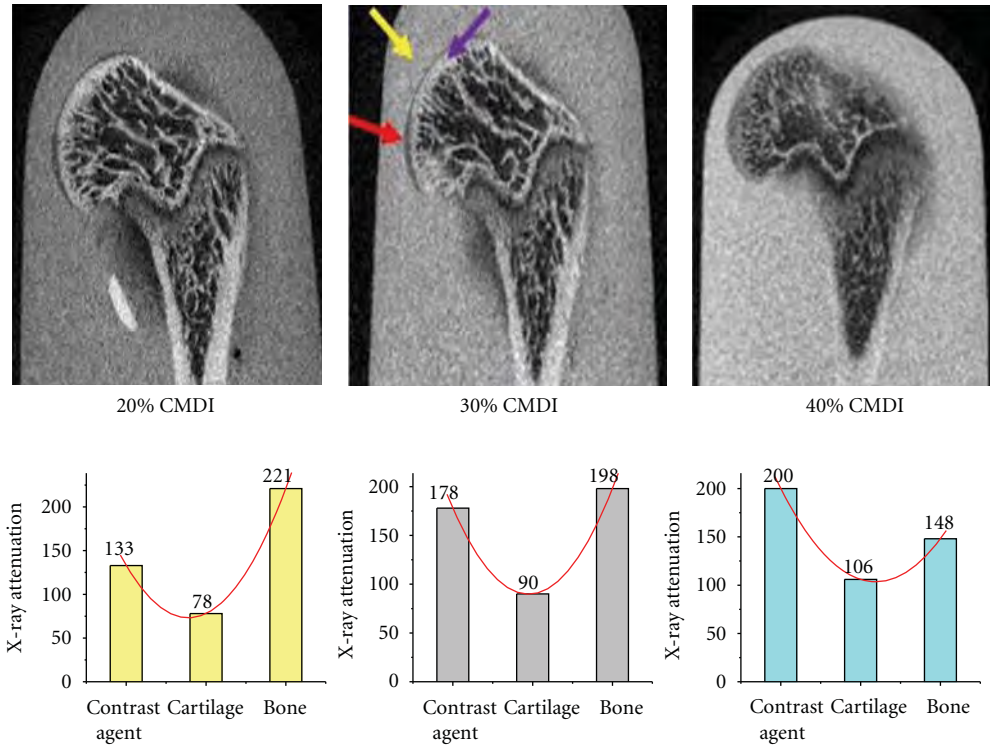

FIGURE 3: The representative sagittal slice of distal femur in 20%, 30%, and 40% CMDI for μ-CT in the rat model, the average X-ray attenuation of contrast agent, articular cartilage, and calcified bone in the corresponding CMDI. Yellow, red, and purple arrows refer to the contrast agent, articular cartilage, and calcified bone, respectively.

slice of distal femur in 20%, 30%, and 40% CMDI for μ-CT in the rat model and the average X-ray attenuation of contrast agent, articular cartilage, and calcified bone in the corresponding CMDI. In 20% CMDI, the average X-ray attenuation of femoral articular cartilage and calcified bone was 78 and 221, respectively. This contrast difference was enough to segment the cartilage from calcified bone, but not enough to differentiate the cartilage from contrast agent accurately. In 40% CMDI, the average X-ray attenuation of cartilage was 106, which was close to that of calcified bone (148). Therefore, it was difficult to distinguish between the cartilage and calcified bone in segmenting by manual. However, when the distal femur was incubated in 30% CMDI, the average X-ray attenuation of contrast agent, cartilage, and calcified bone was 178, 90, and 198, respectively, which provided the appropriate contrast difference for accurately segmenting the cartilage from the contrast agent and calcified bone. In the following scanning, therefore, all the distal femurs were incubated in 30% CMDI to remodel the cartilage.

3.2. Thickness and Volume of Articular Cartilage Determined by μ-CT. According to the above-determined concentration of contrast agent, the incubation in 30% CMDI for 10 min at 37°C was selected as the best protocol. Three distal femurs per group were scanned to obtain the 3D cartilage model. The thickness of articular cartilage exposed to TiO_2 nanoparticles were calculated and shown in Figure 4. At day 1 after exposure to TiO_2 nanoparticles, the thickness of articular cartilage was 0.2754 ± 0.0207 mm, which was smaller than that of the corresponding control (0.2942 ± 0.0150 mm). The changes in cartilage thickness were calculated comparing with that in the corresponding control at each particular time point. The % reduction was calculated as follows.

$$\%\ \text{reduction} = \frac{(\text{thickness in the corresponding control} - \text{thickness in } TiO_2 \text{ exposed rats})}{\text{thickness in the corresponding control}} * 100 \quad (1)$$

At postexposure days 1, 7, 14, and 30, the thickness of articular cartilage was reduced with the rate of 6.41%, 4.52%, 8.64%, and 11.03%, respectively. Comparing with the corresponding control, the significant difference was detected in rats at days 7, 14, and 30 after exposure to TiO_2 nanoparticles ($P < 0.05$) (Figure 4).

Using the 3D cartilage model, the volume of articular cartilage covered on the distal femur was measured and

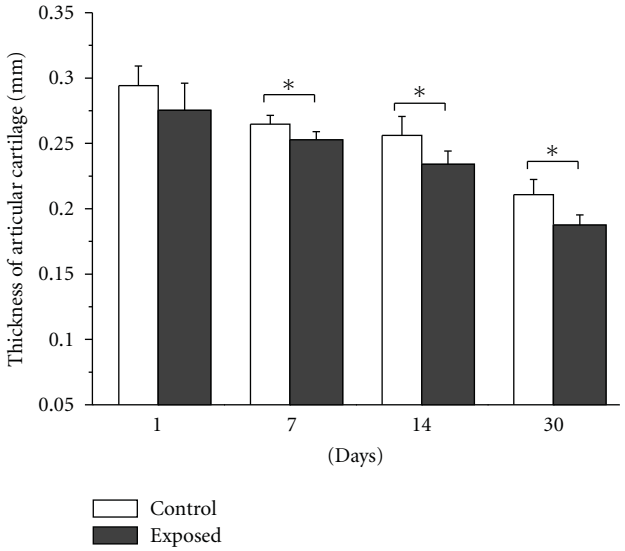

Figure 4: Thickness of articular cartilage in the distal femur by 3D cartilage model. $^*P < 0.05$ compared with the corresponding control.

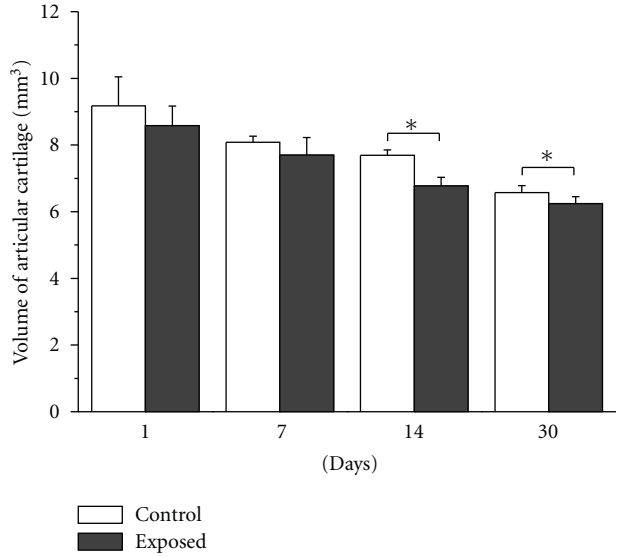

Figure 5: Volume of articular cartilage in the distal femur by 3D cartilage model. $^*P < 0.05$ compared with the corresponding control.

illustrated in Figure 5. At postexposure days 1 and 7, the volume of cartilage showed a little decrease compared to the corresponding control ($P > 0.05$); whereas, at days 14 and 30, the significant reduced cartilage volume was detected ($P < 0.05$). It indicated that the growth of articular cartilage might be disturbed by TiO_2 nanoparticles existed in the joint cavity.

For the control rats at different time points, we determined that the thickness and volume of articular cartilage decreased with the rat age. This was important in cartilage development and consistent with the reported results

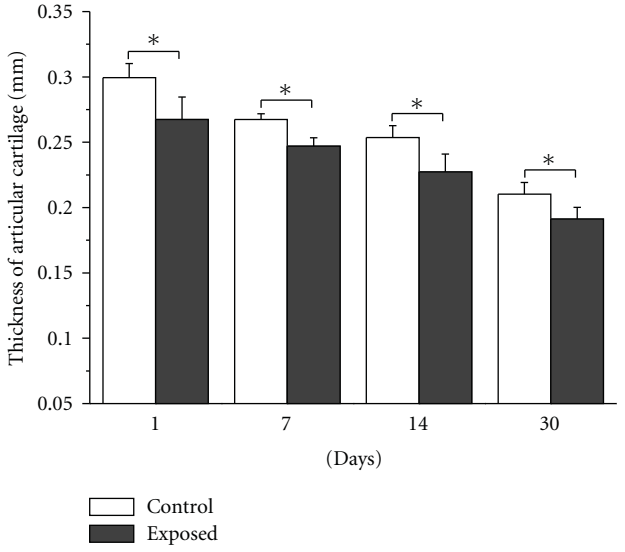

Figure 6: Thickness of articular cartilage in the distal femur by needle probe testing. $^*P < 0.05$ compared with the corresponding control.

[34, 35], which could be due to the endochondral bone development and fibrillation under function adaptation or physiological adaptation in rats during normal growth.

3.3. Thickness of Articular Cartilage Detected by Needle Probe Testing. In testing, the load-displacement curves were recorded as the load probe penetrated to the cartilage with 0.03 mm/min. According to the slope change of the load-displacement curve, the thickness of articular cartilage in distal femur of rats in each group was determined and illustrated in Figure 6. For the control rats, the thickness of articular cartilage became reduced with the rat age increase, which was consistent with the results obtained by the 3D cartilage model. For the rats exposed to TiO_2 nanoparticles, the cartilage thickness showed the significant decrease compared to the corresponding control ($P < 0.05$) at postexposure days 1, 7, 14, and 30, respectively.

These results showed a strong linear correlation ($r = 0.928$, $P < 0.0001$, $n = 48$) with that determined by the 3D cartilage model (Figure 7), which suggested that the determination of cartilage thickness obtained both by 3D cartilage model and by needle probe testing was accurate and creditable.

3.4. Morphology Change of Articular Cartilage. In whole exposure and postexposure period, animals were given food and water *ad libitum*, no abnormal daily activity was observed. After sacrificing the rats, the smooth and moist knee cavity including synovial capsule were observed in the control rats; whereas, the white particles-xanthoproteic complexes were observed in the synovial joint capsule of exposed rats, which indicated the deposition of intra-articular TiO_2 particles. With the time prolong from the postexposure days 1 to 30, the deposited particles-xanthoproteic complexes were reduced, as shown in Figure 8.

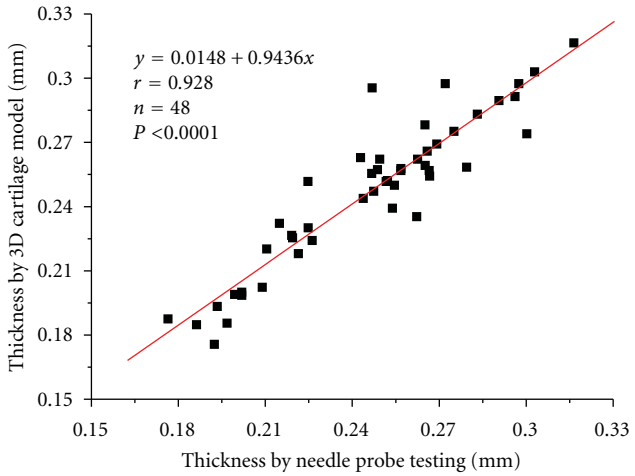

FIGURE 7: The linear correlation between the values of cartilage thickness obtained by 3D cartilage model and needle probe testing. The correlation function $y = 0.0148 + 0.9436$, and $P < 0.0001$ showed a strong linear correlation ($r = 0.928$).

The histopathology of articular cartilage by H&E staining was shown in Figure 9. Both in the control and exposed rats, the articular cartilage had the intact perichondrium and homogenous cartilage matrix. Depending on the arrangement of chondrocytes and collagen fibres, articular cartilage is divided into several zones including the tangential layer, the transitional zone, the radial zone, and the calcified cartilage layer. In the control, the matrix of the calcified cartilage layer stained slightly darker than the matrix of the other cartilage zones. However, at postexposure day 30, the calcified cartilage layer was eosin-stained, which stained lighter than that of the other groups. In the radial and calcified zone of the cartilage, the chondrocyte was edema, and the cell nucleus was shrinked. These implied that the cartilage injury was induced by the intervention of deposited TiO_2 nanoparticles at day 30.

Figure 10 showed the ultrastructure of articular cartilage in the distal femur observed by TEM. After exposure to TiO_2 nanoparticles, the chromatin was condensed and distributed over the fringe of nucleus, the nuclear membrane was invaginated, endoplasmic reticulum was dilated, and ribosomes were decreased in chondrocyte at day 1. The rough endoplasmic reticulum had a lamellar arrangement in the cytoplasm at days 7. The intense axons on the cell surface were developed, and the mitochondria were rich and became swollen in chrondrocyte at day 14. At postexposure day 30, to our surprise, the endoplasmic reticulum ruptured, and the fragments were distributed in the cytoplasm.

4. Discussion

Herein, the impact of TiO_2 nanoparticles on the articular cartilage in the knee joint was reported. By intra-articular injecting the nanoscale TiO_2 suspension, we observed that there was some particles deposition in the knee joint of rats. Using contrast-enhanced high-resolution μ-CT technology, we determined that the cartilage thickness decreased significantly at postexposure days 7, 14, and 30, which has a strong linear correlation ($r = 0.928$, $P < 0.0001$) with the results obtained by needle probe testing. It is reported that the cartilage change would occur on the medial condyle and lateral condyle of femur because of the compression from weight [36]. Articular cartilage is the smooth, glistening white tissue that covers the surface of all the diarthrodial joints. The main structure of cartilage is the "Benninghoff" collagenous fibre (mainly type II collagen) and the hydrated proteoglycan embedded in it to provide the proper biomechanical function. In our previous study [24], the intra-articular TiO_2 nanoparticles resulted in the synovium hypotrophy, oxidative damage, and inflammation, such as lymphocytes and plasma cells infiltration and fibroblast proliferation. Some studies reported that the inflammatory response occurred in synovium was involved in regulating the remodeling of articular cartilage and affecting the chondrocyte function, leading to a loss of cartilage and erosion and weakness of the bones [25, 26]. It is to say that the activated synovial fibroblasts attached to the pannus-cartilage interface and released matrix-degrading enzymes, such as matrix metalloproteinases and the proinflammatory cytokines (TNF-α and IL-1) [26, 37]. The matrix-degrading enzymes would inhibit the synthesis of type II collagen through regulating the chondrocyte and the aggregation of proteoglycans [38]. The reduced extracellular matrix would lead to the thinner articular cartilage. Therefore, in this study, the significant decreased articular cartilage thickness was detected in the distal femur of rats exposed to intra-articular TiO_2 nanoparticles. As determined by the 3D cartilage model, the cartilage thickness reduced about 4.52%, 8.64%, and 11.03% at postexposure days 7, 14, and 30, respectively.

It needs to be pointed out that the thickness and volume of articular cartilage in the control rats also showed a reduction with age. In the weight-bearing joint, studies reported that the cartilage thickness reduced with age both in human [36, 39] and in horse [40]. This is important in cartilage development and ascribed to the endochondral bone development and fibrillation under functional or physiological adaptation. The fetal cartilage is homogenous, showing no site-dependent differences. As the animal gets older and cartilage maturates, cartilage becomes gradually heterogeneous under the influence of joint loading, showing topographical variations in both thickness and compressive stiffness. It is worth to emphasize that Xie et al. [34] also showed that the thickness and volume of cartilage in distal femur decreased in rat during normal growth from 4 to 8 weeks, and even to 16 weeks.

As the only living element of the articular cartilage, the chondrocyte holds a key position in the development of cartilage. It produces the components of the matrix, that is, collagens and proteoglycans. Therefore, besides the above determination of the articular cartilage thickness, the histopathology and ultrastructure of articular cartilage were analyzed in this study to observe the change of chondrocytes after exposure to TiO_2 nanoparticles. Results showed that the chondrocytes were edema and degenerated

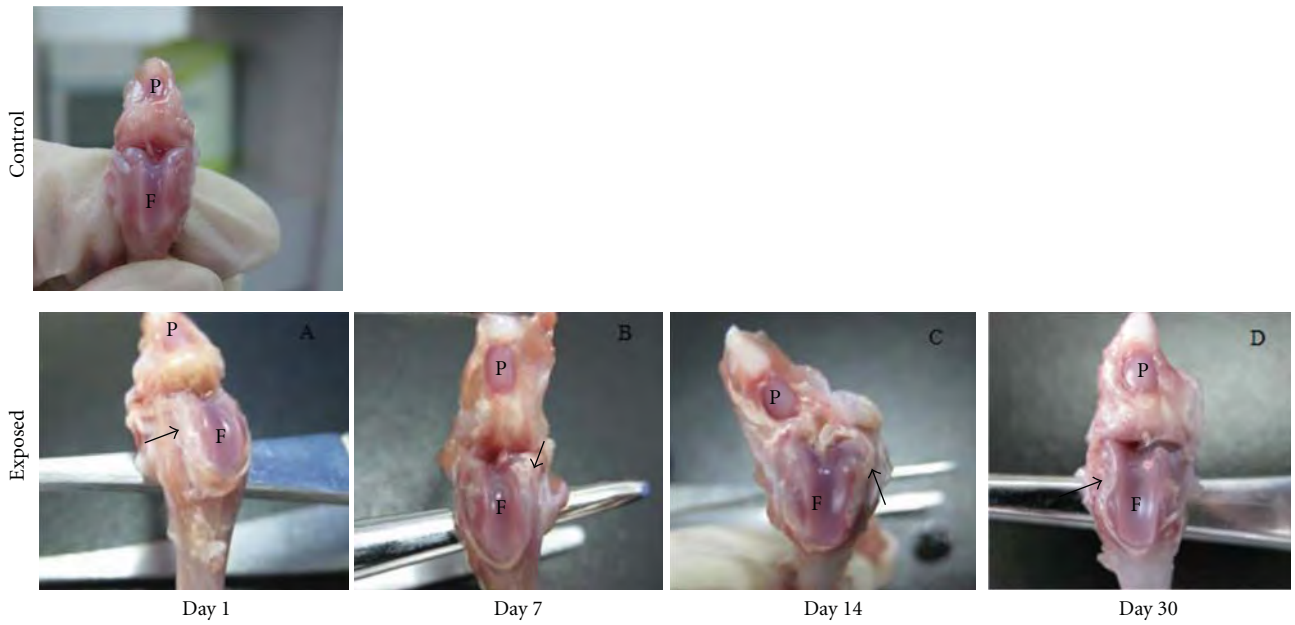

Figure 8: Photograph of knee joint cavity in rats after intra-articular injection of TiO_2 nanoparticles. Control: the smooth and moist knee cavity; exposed: the white particles-xanthoproteic complexes (arrows) in the synovial joint capsule of exposed rats, which indicate the deposition of TiO_2 particles. With the time prolong from the postexposure days 1 to 30, the deposited particles-xanthoproteic complexes were reduced. P: patellar; F: femur.

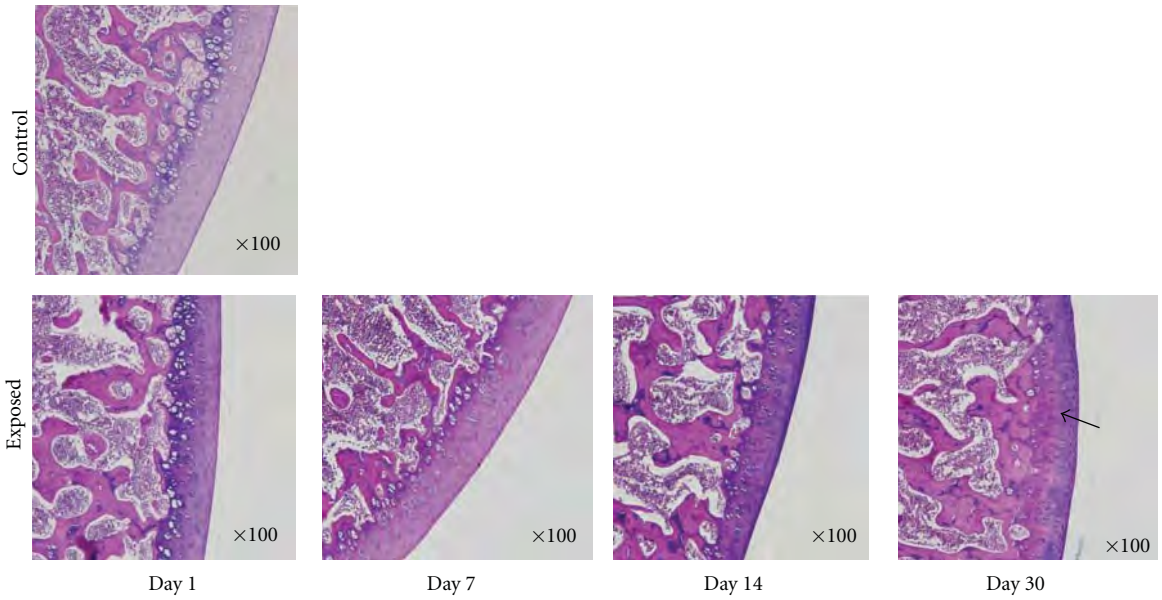

Figure 9: Microphotograph of articular cartilage in the distal femur exposed to TiO_2 nanoparticles by H&E staining. Arrow indicates the edema and degenerated chondrocytes in the radial and calcified zone at postexposure day 30.

in the radial and calcified zone at postexposure day 30. The ultrastructural study of cartilage suggested the degeneration of chondrocyte. More importantly, the mitochondria were rich and became swollen in chondrocyte at postexposure day 14; the endoplasmic reticulum were ruptured in the chondrocyte at postexposure day 30. It is well known that the endoplasmic reticulum plays an important role in the hydroxylation and glycosylation of procollagen, and the mitochondrion takes part in oxidative phosphorylation and functions as the energy factory of cell. The ruptured endoplasmic reticulum would inhibit the synthesis of collagen and glycosaminoglycans [41]. The reduction in matrix synthesis may provide a potential explanation for the thinning of articular cartilage observed in our study. Further, it is reported that chondrocyte promotes the articular cartilage loss because the surface receptors for cytokines respond to

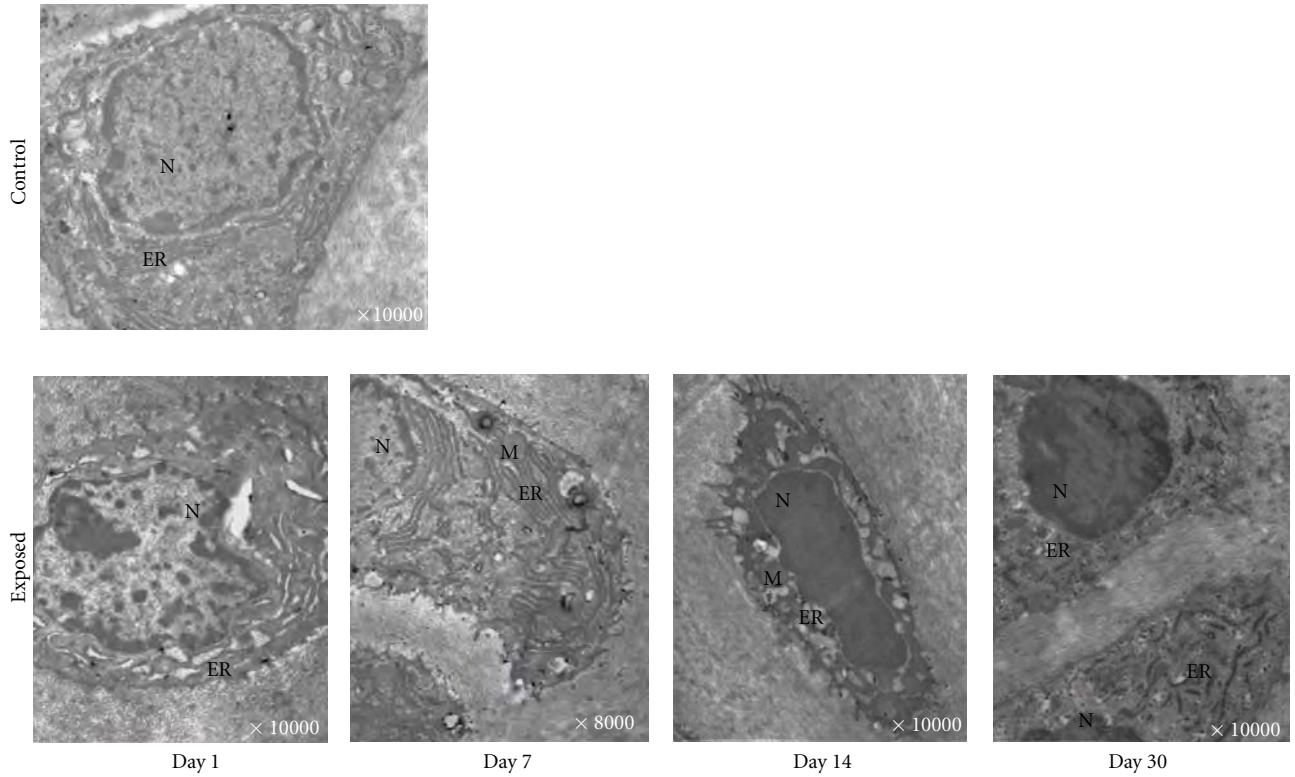

Figure 10: The ultrastructure of articular cartilage in the distal femur exposed to TiO_2 nanoparticles. N: nucleaus; ER: endoplasmic reticulum; M: mitochondria. After TiO_2 nanoparticles exposure, the chromatin was condensed and distributed over the fringe of nucleus, the nuclear membrane was invaginated, the endoplasmic reticulum was dilated, and the ribosomes were decreased in chondrocyte at postexposure day 1. At day 7, a lamellar arrangement for rough endoplasmic reticulum was observed in cytoplasm. At day 14, the intense axons on the cell surface were developed and the mitochondria were rich and became swollen in chondrocyte. At day 30, the endoplasmic reticulum ruptured, and the fragments were distributed in cytoplasm.

the ligands with the production of prostaglandin E_2 and metalloproteinases in synovitis [42]. Of course, to unveil the detailed mechanism of cartilage loss, it is necessary to further research the influence of nanoparticles on the synthesis of extracellular matrix in cartilage, including the collagen and proteoglycan.

5. Conclusion

In conclusion, after intra-articular injection of TiO_2 nanoparticles, we determined that the thickness of articular cartilage was decreased using contrast-enhanced high-resolution μ-CT technology, which had a strong linear correlation ($r = 0.928$, $P < 0.0001$) with the results obtained by needle probe testing. The cartilage thickness was significant decreased with the rat age, and the same trend was observed in cartilage volume. The analysis of morphology and ultrastructure of articular cartilage indicated the chondrocyte was degenerated. Results suggested that the articular cartilage is a potential target for wear particles in knee joint.

Acknowledgments

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TiO_2 nanoparticles translocation and potential toxicological effect in rats after intraarticular injection

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ABSTRACT

Recently, nanomaterials coating gained much concern in orthopedic implants such as bone, cartilage, joint, etc. The wear particles would generate from coating in living organism due to corrosion. In this study, we demonstrated that the intraarticular injected anatase TiO_2 nanoparticles had a potential toxicological effect on major organs and knee joints of rats. The histopathological changes of heart, lung and liver indicated the dissemination of intraarticular TiO_2 nanoparticles from joint cavity to system. In the knee joint, the aggregated TiO_2 nanoparticles deposited and resulted in the synovium hypotrophy and lymphocytes and plasma cells infiltration, but had no effects on cartilage. In the TiO_2-exposed synovium, the oxidative damage was induced because the glutathione peroxidase (GSH-Px), reduced glutathione (GSH), oxidized glutathione (GSSG), and superoxide dismutase (SOD) levels were highly regulated to counteract over-produced free radicals, i.e. hydrogen peroxide (H_2O_2). Further, the lipid peroxidation was detected in the synovium though the expression of proinflammatory cytokines such as tumor necrosis factor alpha (TNF-α) and interleukin (IL-1β) was not much interfered. This research suggested that the amounts of nanocoating in the surface of implants should be controlled and standardized.

1. Introduction

Based on the special properties of nanometric surface topography, such as high specific surface area, roughness and chemical composition, nanobiomaterials have a good prospect in application of biomedical products and orthopedic implants [1–4]. It is reported that nanophase coatings on the surface of commercial pure Ti or Ti alloys implants can modulate protein adsorption and promote cell adhesion, osseointegration and bone mineralization at the bone–biomaterial interface both *in vitro* and *in vivo* [5–10], so that nanomaterials coating gain much concern in the use of bone, cartilage, joint, ligament and vessel. Webster et al. [9] proved that the enhanced osteoblast adhesion on nanophase material was especially dependent on the surface topography such as grain and pore size. The oriented TiO_2 nanotubes with 15–30 nm diameters on titanium surface could accelerate cell adhesion, spreading (integrin clustering) and cellular activities [8].

However, in the nanophase coating of implants, the residual stress remains. Under the chloride-contained physiological fluid and microenvironment around the implants, many wear particles would generate at the bone–implant interface or joint space due to the corrosion, fretting, friction and mechanical loss of prostheses [11,12]. Recently, the nanosized wear particles below 0.1 μm were observed both in joint simulators and in joint periprosthetic tissues [13]. Because of the unique physiochemical properties of nanomaterials such as high surface area, small size and high reactivity, the potential toxic health and environmental effects of nanomaterials were put forward by some scientists and organizations [14–18].

In vivo, nanoparticles would be translocated to and entrapped in other tissues/organs along the blood circulation [19–21]. Berry et al. [22] firstly confirmed the translocation of 30 nm gold particles across the alveolar epithelium into pulmonary capillaries by intratracheal instillation. It is reported the rapid translocation (about 25–30%) of instilled ^{99m}Tc-labeled carbon nanoparticles in 5 min from the lung to the bloodstream of hamsters [23]. In our previous study, the high deposition of TiO_2 in the liver was determined after oral exposure 80 nm TiO_2 particles [24].

In vitro experiments revealed that nanosized TiO_2 (n-TiO_2) particles could catalyze DNA oxidative damage in embryo fibroblasts [25] and lymphoblastoid cells [26], induce oxidative burst and lipid peroxidation in brain microglia [27], and lead to cell death by apoptosis or necrosis in mesenchymal stem cells [28] and U937 monoblastoid cells [29]. Ti and Ti alloys debris significantly influenced the cell proliferation and enzyme induction of synovial fibroblast [30]. The production of reactive free radicals including

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hydroxyl (OH), superoxide anion ($O_2^{\cdot-}$) and hydrogen peroxide (H_2O_2) radicals, and oxidative damage are thought of as the best developed paradigm to study the toxic effects of nanoparticles both *in vitro* and *in vivo* [16,18].

The intraarticular injection is a handy way for doctors to treat rheumatoid arthritis or osteoarthritis, which allows for the injection of steroid, anaesthetic, and hyaluronate. The controlled-release micro- or nanodrugs were also intraarticular injected to deal with arthropathy [31]. In this paper, to simulate the release of wear nanoparticles into joint cavity produced from nanocoated surface of implants in total joint prostheses, the intraarticular nanoparticles injection was performed. We aim to investigate the biological effect of intraarticular injected TiO_2 nanoparticles (anatase, purity >99.8%) on major organs of rats. Serum biochemical parameters and histopathology were investigated to evaluate the potential injury of tissues. The contents of antioxidants, lipid peroxidation and proinflammatory cytokines in the synovial membrane were also analyzed to indicate the oxidative stress and immune response in knee joint.

2. Materials and methods

2.1. Materials

TiO_2 nanomaterials were provided by Hangzhou Wan Jing New Material Co., Ltd. It's purity is higher than 99.8%. The crystal profile was characterized by automatic X-ray diffractometer (XRD, Rigaku D/max 2200 PC, Japan) equipped with RINT2000 wide angle goniometer. The data were collected in the mode of continuous scanning with power setting of 40 kV, 100 mA, scanning speed of 6°/min using Cu Kα radiation ($\lambda = 0.154$ nm).

TiO_2 nanomaterials were suspended in ultrapure water and ultrasonicated for 5 min × 10 circles. The suspension was dipped on the cleaned silicon wafer and dried in an oven at 45 °C. The morphology and particle size of n-TiO_2 particles were obtained by scanning electron microscopy (SEM, Hitachi S-4800, Japan). In addition, the microstructure profile of n-TiO_2 was obtained with a high resolution transmission electron microscopy (TEM, JEM-2100F, Japan). The ultrapure water was prepared with a resistivity of 18.2 MΩ cm (PureLab Plus, PALL, USA). Bovine serum albumin and Coomassie brilliant blue G-250 were purchased from Sigma. Phenylmethanesulfonyl fluoride (PMSF) was provided by Roche. All of other reagents used in this study were at least of analytical grade.

2.2. Animals

Male Sprague Dawley rats (180–200 g body weight, Experimental animal center of Peking University) were housed in polycarbonate cages placed in a ventilated, temperature-controlled room. The standard conditions were supplied and maintained at 20 ± 2 °C room temperature, 60 ± 10% relative humidity, and 12 h light/dark cycle. The commercial pellet diet and distilled water for rats were available *ad libitum*. All procedures used in this animal studies were compliant with the local approved protocols of the Administration Office Committee of Laboratory Animal. Animals were acclimated to this environment for five days prior to treatment.

2.3. Experimental protocol

We prepared n-TiO_2 suspension using physiological saline solution at three different concentrations of 0.2, 2, and 20 mg/ml, respectively. Briefly, the powdered TiO_2 nanoparticles were dispersed in the fresh sterilized saline solution, and the mixture was ultrasonicated for 3 min in 4 °C at 200 W to disperse completely as well as possible. Then, to determine the dispersion and aggregation status of n-TiO_2 particles in physiological solution, the dynamic light scattering (DLS) method was performed by particle size analyzer (PSA, 90-Plus, Brookhaven Inst. Corp., NY) equipped with a 50 mW solid state argon-ion laser excitation on 659 nm, a BI-9000AT digital correlator, a BI-200SM goniometer and a temperature controller. The normalized particle size distribution was calculated by Brookhaven Instruments particle sizing software.

Forty rats with weights ranging from 180 to 200 g were randomly assigned to four groups: control, low, middle and high group based on weight (10 rats per group). Before treatment, animals were anesthetized by 30 mg/kg bw i.p. sodium pentobarbital (Germany). The furs on bilateral hind knees were shaved softly after soaking with soaps liquid, and the povidone iodine was applied over the site with a cotton carrier to prevent infection. Based on previous works of Ti and Ti–Al metallic wear debris in clinical study [32,33], the two hind knee joints were intraarticular injected with 100 ul of 0.2 mg/ml (0.2 mg/kg, low group), 2 mg/ml (2 mg/kg, middle group), and 20 mg/ml (20 mg/kg, high group) TiO_2 suspensions, respectively. The equal volume physiological solution was given to the control rat every other day for 4 times. Following the exposure, all animals were held for post-exposure period of 7 days. After fasting over night, all animals were anesthetized to collect the blood. By centrifugation at 3000 rpm for 10 min, the serum was harvested for biochemical parameters assay. The tissues/organs such as heart, liver, spleen, lung and kidney, especially the hind knee joint and synovial membrane were excised out for histopathology examination. The knee joints were lavaged by 100 μl physiological solution for 2 times, and the lavage fluid was kept in −80 °C for later use.

2.4. Coefficients of organs

Seven days post-exposure, the rats were killed and organs including heart, liver, spleen, kidneys and lung, were excised out and weighed accurately. The coefficients of organs to body weight were calculated as the ratio of organs (wet weight, mg) to body weight (g).

2.5. Assay for serum biochemical parameters

In this study, the serum biochemical markers were assayed using a Biochemical Autoanalyzer (Type 7170, Hitachi, Japan). Creatine kinase (CK) activity and hepatic function with levels of alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (AKP) and lactate dehydrogenase (LDH) were measured by commercial kits (Biosino bio-technology and science incorporation Co. Ltd.). Total bilirubin (TBIL), blood urea nitrogen (BUN) and creatinine (Cr) were evaluated for renal function and the content of fasting blood glucose (Glu) was also detected in serum.

2.6. Histopathological examination

A part of tissues/organs such as heart, liver, spleen, lung, kidney and synovium was cut out and immediately fixed in a 10% formalin solution. The histopathological tests were performed using standard laboratory procedures. The tissues were embedded in paraffin blocks, then sectioned into 5 μm sections and mounted onto the glass slides. The hematoxylin–eosin (HE) staining protocol was applied to these sections.

The knee joint was fixed in a 10% formalin solution and decalcified with 10% nitric acid for 24 h and embedded in paraffin to allow for 5 μm sections. They were stained with hematoxylin–eosin for microscopic analysis. In addition, cartilage was stained by toluidine blue staining to observe the chondrocyte. All sections were observed and the photos were taken using optical microscope (Nikon U-III Multipoint Sensor System, USA). The identity and analysis of pathology sections were blind to the pathologist.

2.7. Assay of enzymatic activities in synovium tissue

The synovium with subsynovium tissues per group were weighed and embrittled by liquid nitrogen, and minced by knife and transferred into a centrifuge tube. The 1:9 (W/V) volume of cold 0.1 mol/L phosphate buffer (0.1 mol/L Na_2HPO_4, 0.1 mol/L KH_2PO_4, 0.1 mmol/L PMSF, pH 7.4) was added, and the mixtures were homogenized by a ultrasonic cell disruptor (JY92-II, Ningbo Scientz Biotechnology Co., Ltd., China) for 5 s × 20 circles with 9 s intervals at the power of 300 W in 4 °C. The homogenization was centrifuged at 14,000*g* for 10 min in 4 °C (Universal 32R, Hettich zentrifugen, Germany), collecting the supernatants to assay some oxidative biomarkers. The activity of glutathione peroxidase (GSH-Px), and the levels of reduced glutathione (GSH), oxidized glutathione (GSSG), H_2O_2, superoxide dismutase (SOD) and lipid peroxidation in synovium were examined according to the method used in Wang et al. [34]. The above reagents and kits were provided by Nanjing Jiancheng Bioengineering Institute (Jiangsu, China). Briefly, the activity of GSH-Px was assayed by determination of the reduced GSH in the homogenate according to the standard substrate, i.e. 1-chloro-2,4-dinitrobenzene (CDNB) conjugated with GSH. The lipid peroxidation product was measured using the thiobarbituric acid (TBA) assay for malondialdehyde (MDA) content. H_2O_2 content in the homogenate was determined by the routine method of adding ammonium molybdate in the reaction system [35]. Protein concentrations were determined according to Bradford's method [36], using bovine serum albumin as a standard.

2.8. Measurement of proinflammtory cytokines

The cytokines of TNF-α and IL-1β in the joint lavage fluid and synovium homogenate were analyzed by enzyme linked immunosorbent assay (ELISA) kits that is specific for rat (Biosource International, Inc., USA). The assays were performed strictly according to the manufacturer's instructions. Photometric measurements were conducted at 450 nm using a 96-well microplate reader (Bio-rad 550, USA). The detection limit of each assay was less than 4 pg/ml for TNF-α and 3 pg/ml for IL-1β.

2.9. Statistical analysis

For statistical analysis, all data are expressed as mean ± standard deviation (SD). The statistical software SPSS for windows 13.0 was used to perform a post-hoc multiple comparison test such as LSD and Turkey's test following a one-way analysis of variance (ANOVA). $p < 0.05$ was considered as the statistical significance.

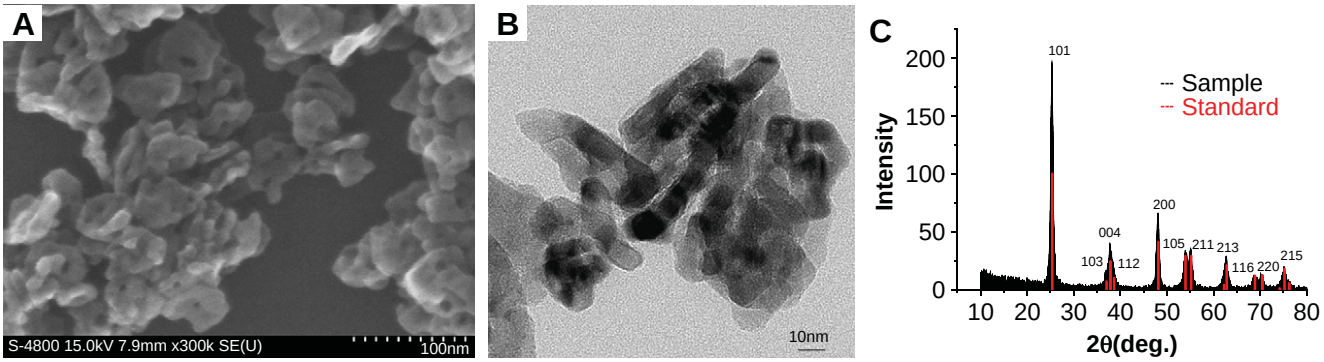

Fig. 1. Morphology and microstructure characterized by SEM (A) and TEM (B) and X-ray diffraction pattern (C) of TiO_2 nanoparticles.

3. Results

3.1. Characterization of TiO_2 nanoparticles

The microstructure, morphology, particle size and crystal profile of TiO_2 nanoparticles were characterized by SEM, TEM and XRD (Fig. 1). From SEM images, we observed that n-TiO_2 particles were red blood cells-like wafers with the average diameter of 45.87 ± 7.75 nm, the thickness of 10–15 nm, and the average pore size of 7.50 ± 2.58 nm (Fig. 1A). The TEM micrographs of TiO_2 showed nearly belt or sheet structure with the length of 45.35 ± 8.70 nm and the width of 13.42 ± 3.94 nm (Fig. 1B), which was well consistent with the average diameter and thickness obtained by SEM, respectively. The pure anatase profile of TiO_2 nanoparticles was observed from XRD spectrum (Fig. 1C).

Further, dynamic light scattering measurement showed the aggregation ability and distribution of particle size in aqueous media. The hydrodynamic diameter distribution of n-TiO_2 particles in physiological solution is shown in Fig. 2. The two distribution peaks ranging from 183.7 to 282.0 nm and from 575.6 to 1018.9 nm were detected, which indicated that much TiO_2 particles were clustered and aggregated in solution.

3.2. Coefficients of organs

During whole exposure, no other abnormal daily activity and symptoms were observed except that all rats were unwilling to move and like to rest within 6 h after injection. The body weight in whole exposure period is illustrated in Fig. 3. There were no significant changes between the control and exposed groups both in the exposure period and post-exposure period. After sacrificing all rats at 7 days post-exposure, the coefficients of organs to body weight were determined and shown in Table 1. In the low group, there was no obvious difference from the control for the coefficient of each organ to body weight. In the middle group, the spleen showed significantly higher coefficient than the control ($p < 0.05$) and the lung coefficient was slightly increased. In the high group, the lung and kidney presented significant higher coefficients ($p < 0.05$), and the increased heart coefficient was also determined though no significant difference existed comparing with the control ($p > 0.05$).

3.3. Changes of serum biochemical parameters

To investigate the physiological changes in rats after intraarticular injecting n-TiO_2 particles, the serum biochemical parameters were detected (Table 2) at 7 days post-exposure. Generally, the levels of TBIL, AKP, ALT and AST markers were determined to evaluate the liver function. In the low group, the levels of these parameters were similar to that in the control ($p > 0.05$), except that the AKP and Cr showed the significant decreased levels. In the middle and high groups, the ratio of AST/ALT, a sensitive indicator for hepatic injury, was significantly higher than the control ($p < 0.05$), though the activity of ALT was lower than the control and the AST activity was a little higher ($p > 0.05$). Nevertheless, the LDH was over-released

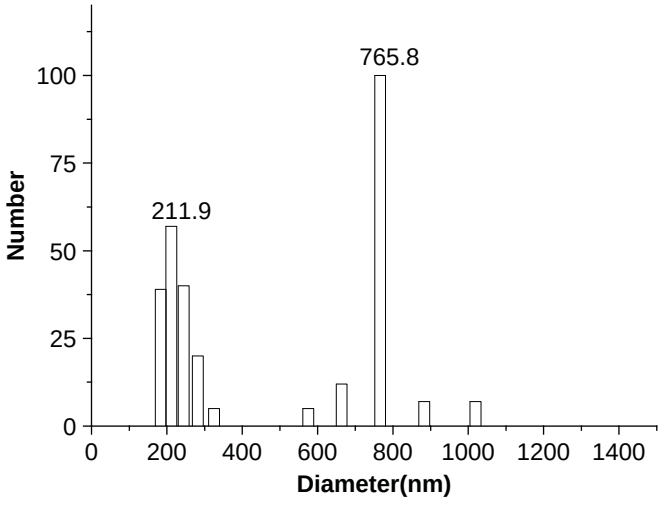

Fig. 2. Hydrodynamic diameter distribution of TiO_2 nanoparticles in physiological solution.

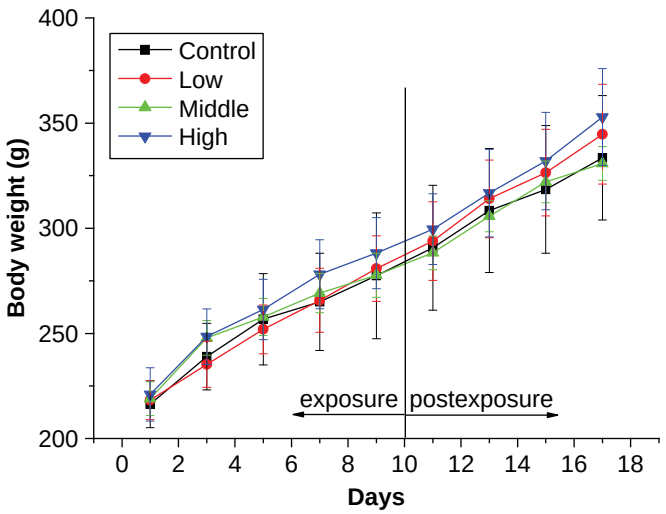

Fig. 3. Body weight increase of rats ($n = 10$) during exposure and post-exposure period.

Table 1
Coefficients of major organs in rats ($n = 10$) intraarticular injected TiO_2 nanoparticles at 7 days post-exposure.

Groups	Heart (mg/g)	Liver (mg/g)	Spleen (mg/g)	Lung (mg/g)	Kidney (mg/g)
Control	3.80 ± 0.34	34.62 ± 3.67	2.34 ± 0.34	4.36 ± 0.59	8.02 ± 0.47
Low	3.83 ± 0.20	31.96 ± 1.84	2.57 ± 0.34	5.18 ± 1.49	7.97 ± 0.45
Middle	3.95 ± 0.44	32.21 ± 2.08	$3.09 \pm 0.51^{*,+}$	4.71 ± 1.18	8.38 ± 0.58
High	4.06 ± 0.55	32.89 ± 2.85	2.63 ± 0.60	$5.79 \pm 2.14^{*}$	$8.44 \pm 0.26^{*,+}$

$^{*}p < 0.05$ significant difference comparing with the control group.
$^{+}p < 0.05$ significant difference comparing with the low group.

both in the middle and high groups ($p > 0.05$), and the significant difference was detected comparing with the low group ($p < 0.05$).

The levels of BUN and Cr in the middle group, comparing with the control, were significantly decreased. In the rats exposed to high n-TiO_2, the downregulated BUN level and significantly decreased Cr content were detected. In addition, the fasting serum glucose was decreased in all exposed rats.

3.4. Pathological changes in tissues

At 7 days post-exposure to n-TiO_2 particles, the heart, lung, liver, spleen, kidneys, especially knee joint and synovium tissues were excised out and processed for pathological examination. To our surprise, the heart and lung were injured after intraarticular injection n-TiO_2 particles. In the heart, the dispersed and aggregated brown particulates were observed in interstitial fascicle, cytoplasm and nucleus of vascular cells of ventricular endocardium (Fig. 4). The swollen vascular endothelial cells were also observed in the heart. In the lung tissue, the follicular lymphoid hyperplasia with inflammatory cells aggregated around bronchia was found in TiO_2-exposed rats (Fig. 5B–D). It is notable that in the middle and high TiO_2-exposed rats, many brown particulates deposited in the pulmonary microvascular associating with passive lung congestion (Fig. 5C–F). Particles phagocytosed by macrophage were observed in the pulmonary alveoli. Inside the pulmonary alveolus, the inflammatory cells, such as neutrophils, lymphocytes and eosinophils could be found (Fig. 5E–F). The thickened alveolar walls were discovered in the lung of high TiO_2-exposed rats.

In the liver, the injury was observed around the central vein and portal area (Fig. 6). Many vacuoles around the central vein were induced, indicating the fatty degeneration of hepatocytes. The inflammatory responses represented as the lymphocyte clusters, neutrophils and monocytes concentrated at portal area and the hepatic sinusoid dilation. The injury would much more severe with the treated dose increase. Fig. 7 shows the pathological micrographs of kidneys in rats at 7 days post-exposure. In renal proximal tubules, the deposition of proteinic liquid was observed from slight to severe with the treated dose increase. In the spleen, no abnormal pathological change was examined.

After sacrificing all rats, the knee joints were photographed and shown in Fig. 8. In the control group, the surface of knee joints was clean and smooth, whereas, the high TiO_2-exposed knee joints were coarse and covered with particles-xanthoproteic complex, which indicated the deposition of TiO_2 particles. Further, the histopathological changes of knee joints and cartilage were examined by HE and toluidine blue staining (Figs. 9 and 10). After exposure to different-dosed TiO_2, the smooth, glistening surface and the normal morphological structure were observed in the articular cartilage (Fig. 9(1)). In the synovial membrane, the slightly synovium hypertrophy and little particulate deposition were found in the low TiO_2-exposed rats. However, many brown particles accumulated in the synovium of high TiO_2-exposed rats. The obvious inflamed synovium were induced, presenting as the significant synovium hypertrophy, lymphocytes and plasma cells infiltration, and fibroblast proliferation (Fig. 10).

3.5. Oxidative damage in synovium

Because of the deposition of TiO_2 particles in the synovium, the biological responses were determined by assaying the antioxidative enzymes and antioxidants in the synovium (Figs. 11 and 12). The results showed that GSH-Px and SOD, the endogenous antioxidative enzymes, in each exposed group exhibited higher activities than the control. In the low and middle groups, total GSH and GSSG contents were not different from the control ($p > 0.05$), but the GSH-Px activity was significantly increased. $p < 0.05$ was detected between the TiO_2-exposed and control rats. In the high TiO_2-exposed group, the significantly upregulated GSH-Px, GSH and GSSG contents were detected in the synovium ($p < 0.05$). These increased biomarkers, as antioxidants *in vivo*, were thought of initiating a self-immune action to counteract the over-produced H_2O_2 level (Fig. 11(4)).

SOD and MDA levels were used to reflect the level of oxidative damage in tissues. In this study, SOD in the low and middle groups exhibited significantly higher activity than the control, and the MDA content was significantly increased (Fig. 12). However, in the high group, their levels were not significantly different from the control.

Based on the above results, the proinflammatory cytokines TNF-α and IL-1β were determined in the joint lavage fluid and in the synovium homogenate to reflect whether or not the immune responses occurred (Fig. 13). Results showed that the contents of TNF-α and IL-1β in the synovium homogenate did not significantly be influenced in the TiO_2-exposed rats. In the joint lavage fluid, the changes of TNF-α and IL-1β expression were not detected, too.

4. Discussion

In clinical, previous study reported that the number of wear particles in tissue adjacent to total joint implants ranged from 0.85 to 141.85×10^9 particles/g dry tissue, and the diameter of wear particles was from approximately 0.58 μm to 0.79 μm, even up to more than 100 μm [33]. Agins et al. [32] revealed that the content of titanium wear particles in the tissue adjacent to the prosthesis was from 56 to 3700 μg/g dry tissue. The metallic wear particles disseminated to the liver and spleen were less than 1 μm in patients with total hip and knee replacement [37]. Additionally, researches have proved that a biomaterial substrate with nanometer composition was biologically preferred [1,2]. Considering the previous

Table 2
Changes of biochemical parameters in serum of rats ($n = 10$) after intraarticular injected TiO_2 nanoparticles at 7 days post-exposure.

Groups	CK (U/L)	LDH (U/L)	TBIL (μmol/L)	AKP (U/L)	ALT (U/L)	AST (U/L)	AST/ALT	BUN (mmol/L)	Cr (μmol/L)	Glucose (mmol/L)
Control	2555.1 ± 625.7	1093.6 ± 290.5	1.84 ± 0.30	235.79 ± 58.43	46.40 ± 4.99	130.2 ± 16.8	2.82 ± 0.31	7.23 ± 0.60	68.10 ± 2.69	6.48 ± 1.39
Low	2262.3 ± 789.6	911.0 ± 236.4	1.99 ± 0.32	$152.61 \pm 32.54^{*}$	42.67 ± 3.54	125.6 ± 14.6	2.94 ± 0.25	6.51 ± 1.10	$64.11 \pm 3.89^{*}$	6.39 ± 0.81
Middle	2228.0 ± 439.5	$1329.0 \pm 410.4^{+}$	$1.72 \pm 0.19^{+}$	213.66 ± 26.37	$41.70 \pm 4.95^{*}$	$151.9 \pm 30.9^{+}$	$3.66 \pm 0.70^{*,+}$	$6.48 \pm 0.89^{*}$	$61.80 \pm 4.44^{*}$	$5.31 \pm 1.30^{*}$
High	2370.1 ± 471.8	$1332.0 \pm 296.2^{+}$	1.87 ± 0.22	$170.33 \pm 17.66^{*}$	43.40 ± 3.98	148.5 ± 30.4	$3.41 \pm 0.54^{*,+}$	6.74 ± 0.65	$62.80 \pm 2.66^{*}$	5.81 ± 0.48

$^{*}p < 0.05$ significant difference comparing with the control group.
$^{+}p < 0.05$ significant difference comparing with the low group.

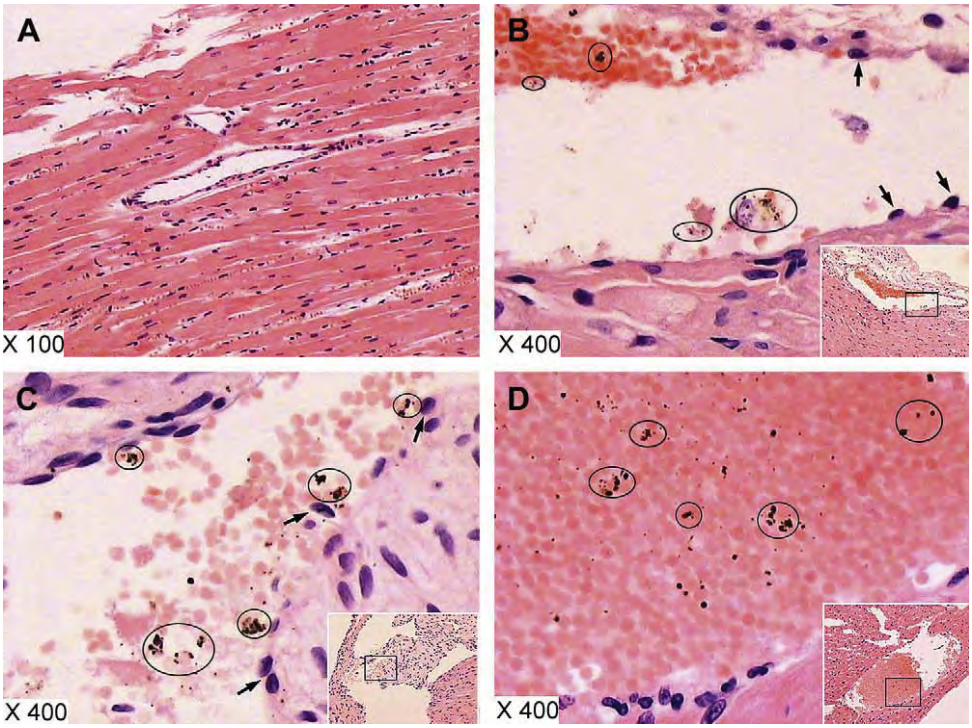

Fig. 4. Histopathological micrographs of heart in rats at 7 days post-exposure after intraarticular injection TiO_2 nanoparticles. (A) Control group (B) low group (C) middle group (D) high group circles indicate the brown particulate deposition; arrows indicate the swollen vascular endothelial cells.

reports, in this study, we selected n-TiO_2 particles with 45.8 nm diameter, 13.4 nm thickness and 7.5 nm pore size. By intraarticular injection, TiO_2 nanoparticles would actually reflect wear debris produced in arthroplasty clinically. The dose designed for the experiment was from 0.2 to 20 mg/kg per rat every other day, which was lower than the detected Ti particles in patients clinically. The dose was determined to investigate the translocation and toxicity response of TiO_2 nanoparticles at a lower exposure level, in order to provide some useful information for nanocoated implants design.

4.1. Potential damage of intraarticular injected TiO_2 nanoparticles on major organs

In joint cavity, the articular cartilage is avascular and alymphatic and is innervated. The synovial membrane sieves the blood and secretes synovial fluid, which contains hyaluronan and lubricin to lubricate the joint surfaces. In this study, after intraarticular exposure to low TiO_2 nanoparticles, the slight histopathological change was examined in major organs such as heart, lung, and liver of rats. In the middle and high TiO_2-exposed rats, the severe changes were induced representing as sediment of brown particles and infiltration of inflammatory cells, especially in the lung and heart. Considering of no blood or lymph applied in the joint, the absorption, translocation and targets of intraarticular n-TiO_2 particles would be different from traditional exposure methods [24,38–40]. By oral exposure, the liver and kidney were targeted because n-TiO_2 particles were absorbed by the mesentery lymph to blood circulation [40]. By intranasal instillation, the olfactory bulb and central nervous system were the target of inhaled nanoparticles because of the special intricate network of sensory nerve endings between the nose and olfactory bulb [18,39]. In the synovial membrane of knee joint, it is well known that the highly organized and fenestrated capillaries distributed. Generally, the maximum diameter of particles that move across the synovial capillary wall is 50 nm, but in joint disease or with the active movement of knee joint, the vascular plasticity leads to redistribution of vascular bed and may compromise its functional ability. The large polystyrene particles up to 240 nm could permeate and retain in the endothelial wall and in the peripheral cells of synovial capillaries and then transported to other sites [41]. DLS result, in our study, showed that the aggregated diameter of n-TiO_2 in physiological solution was from 183.7 to 282.0 nm and from 575.6 to 1018.9 nm. Therefore, after intraarticular injected TiO_2 nanoparticles, the smaller aggregated nanoparticles could penetrate the synovial capillaries to the venous flow and transport to heart or lung tissues with the blood circulation, while larger aggregated particles still deposited in the knee joint. Similar results have been reported by Urban et al. [37] that the diameter of particles disseminated to the liver and spleen was less than 1 μm in patients. While, only a little ^{166}Ho-chitosan complex (DW-166HC) was transported to lung, abdomen, and pelvis at 24 h after intraarticular injection in patients [42]. The translocation of nanoparticles in knee joint to other sites might be related with the permeability of loose connective subsynovium [43] and the surface property of particles, such as particle size and surface activity [18]. Additionally, the intraarticular n-TiO_2 particles also might be drainaged by lymphatic vessels [37,43] which are numerous and prominent in inflamed synovial tissues.

Ferin et al. [44] reported that 20 nm TiO_2 particles penetrated more easily into the pulmonary interstitial space than 250 nm TiO_2 at equivalent masses and produced the marked inflammatory response in the lung. In this study, at 7 days post-exposure, we observed the brown particulates deposited in vascular endothelial cells and in alveolar macrophages in the histopathological observation (Figs. 4–6). Depending on particle size and surface chemistry, TiO_2 nanoparticles were reported to be phagocytosed by the endothelial cells and macrophages after injection. The phagocytosed particles probably activate both the endothelial cells and macrophages to release some inflammatory cytokines and chemokines [45]. Moreover, when macrophages were overloaded by nanoparticles, it is hypothesized that the interaction between nanoparticles and epithelial cells would

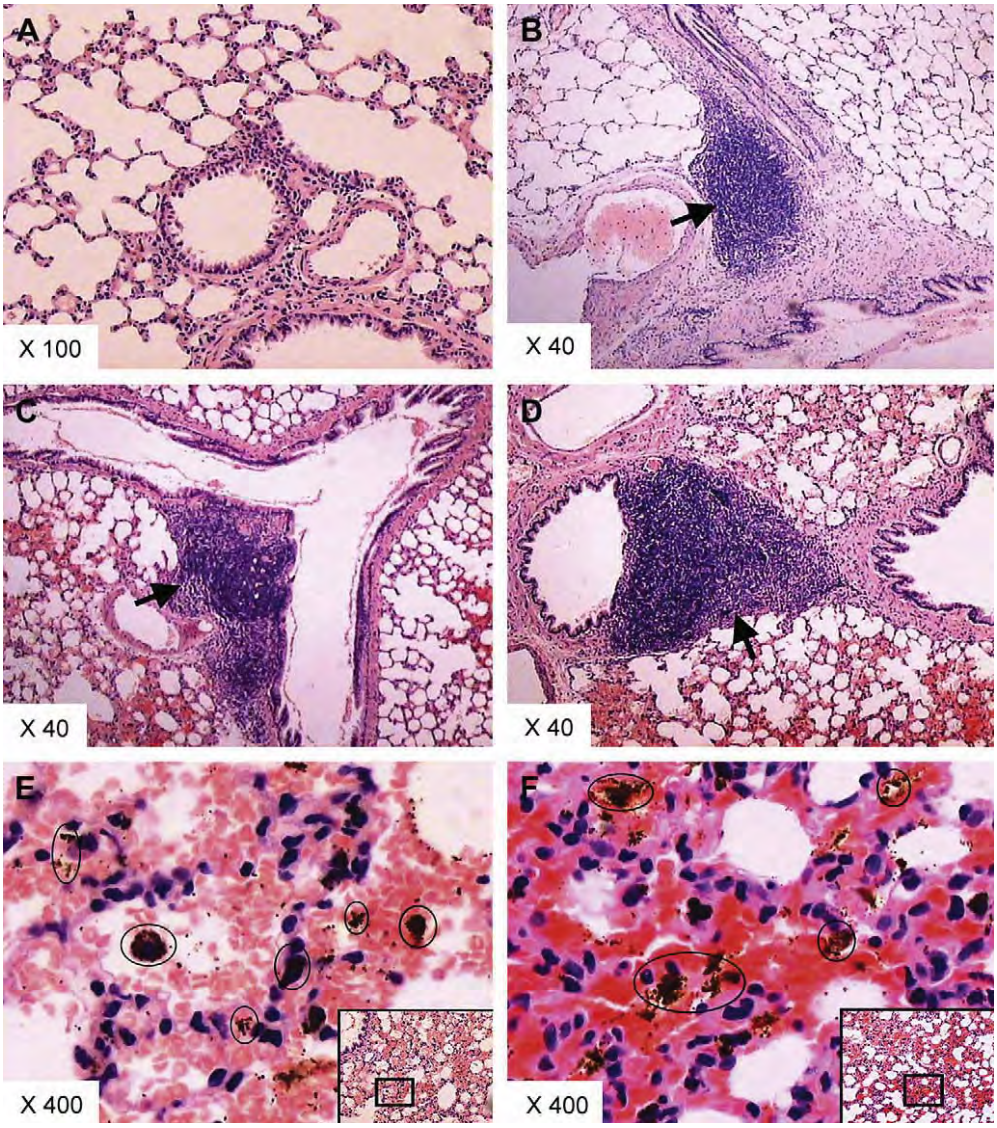

Fig. 5. Histopathological micrographs of lung in rats at 7 days post-exposure after intraarticular injection TiO_2 nanoparticles. (A) Control group (B) low group (C&E) middle group (D&F) high group. Arrows indicate the follicular hyperplasia of the lymph node at trachea forks. E & F show the brown particulates deposition and particle-laden alveolar macrophages (circles).

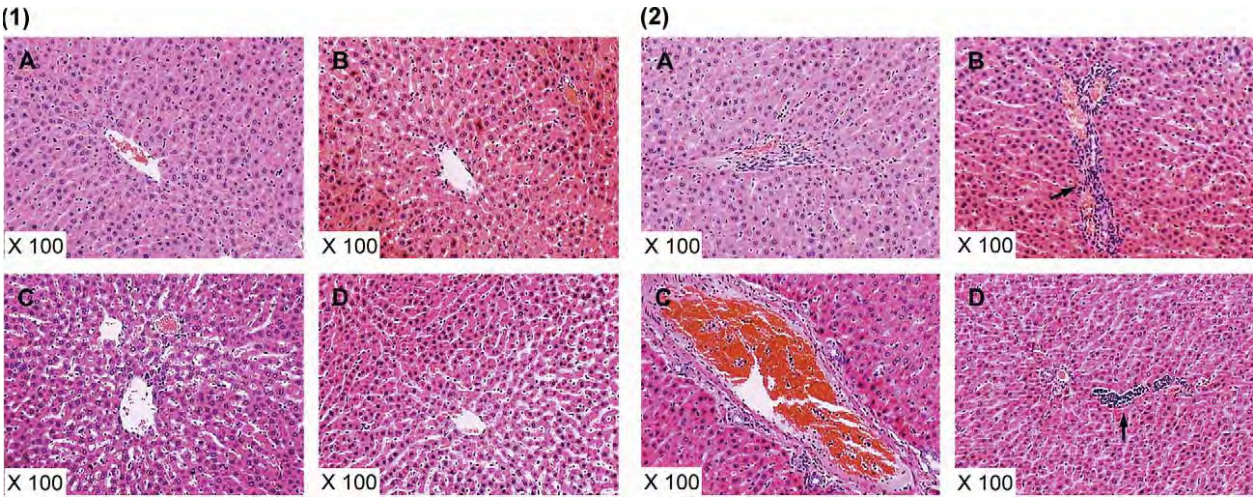

Fig. 6. Histopathological micrographs of liver in rats at 7 days post-exposure after intraarticular injection TiO_2 nanoparticles. (A) Control group (B) low group (C) middle group (D) high group. Part (1) shows the fatty degeneration of hepatocytes around central vein; part (2) shows the infiltration of inflammatory cells in portal area.

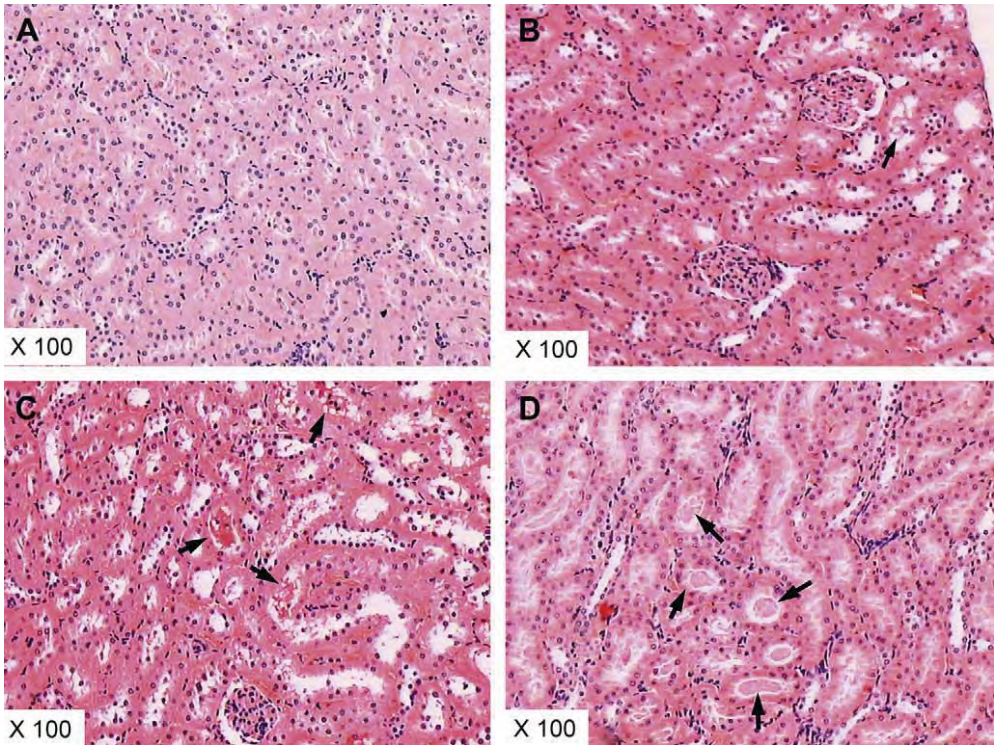

Fig. 7. Histopathological micrographs of kidneys in rats at 7 days post-exposure after intraarticular injection TiO_2 nanoparticles. (A) Control group (B) low group (C) middle group (D) high group. The proteinic liquid deposited in renal proximal tubules.

be prolonged and lead to epithelial cell oxidative stress and secretion of inflammatory cells. In the histopathological examination, the neutrophils, lymphocytes, monocytes and eosinophils were also observed, which demonstrated that the acute inflammatory reaction was induced in the organs. This is corresponded with that of previous studies reported [24,38]. The unique properties of nanoparticles lead to its difficult excretion *in vivo*. The retention halftime of nanoparticles was 541 days for 20 nm TiO_2 and 117 days for 250 nm TiO_2 in rat lung [46]. In the high group, the difficult clearance of nanoparticles in the lung and liver would result in the increased organ coefficients in the high group (Table 1) and upregulated serum AST/ALT level.

4.2. Influence of nanoparticles on knee joint

In the knee joint, the superficial synovial layer is unicellular and consisted of synoviocytes referred to as macrophage A cells and fibroblast-like B cells, and the deeper layers are mainly fibroblasts with few macrophages and mast cells. The macrophage A cells possess numerous vesicles, vacuoles and lysosomes as well as

Fig. 8. Morphology of knee joint in rats after exposure to TiO_2 nanoparticles at 7 days post-exposure.

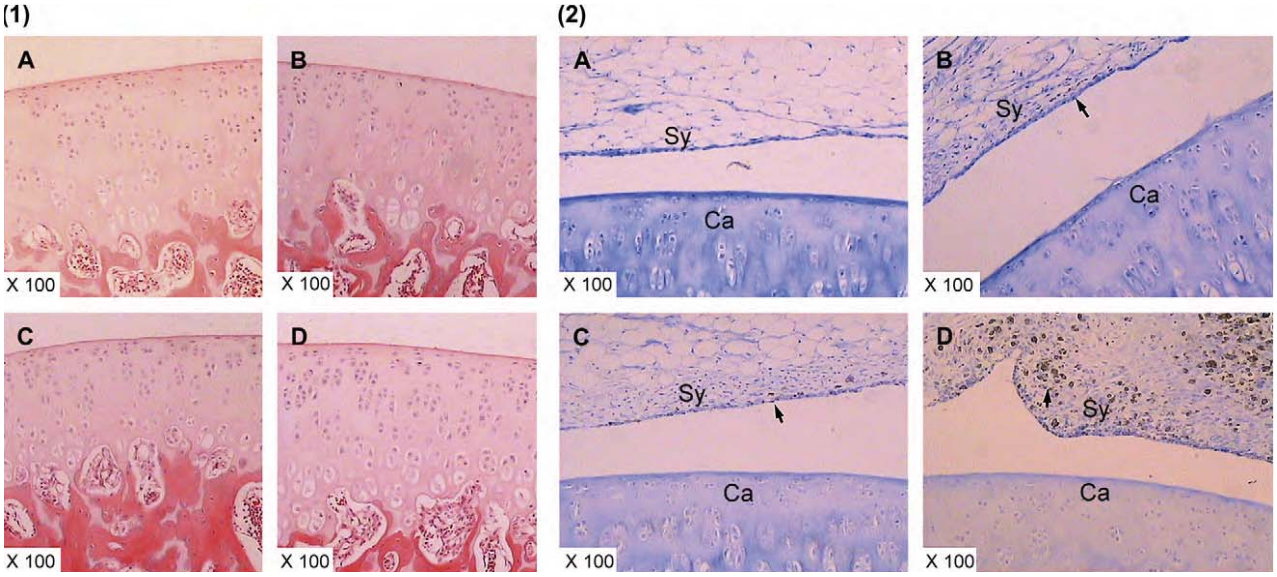

Fig. 9. Histopathological micrographs of articular cartilage (1) and knee joint (2) of rats at 7 days post-exposure after intraarticular injection TiO_2 nanoparticles, showing smooth surface and normal morphological structure of articular cartilage; brown particulates deposition in the synovium tissue (Arrows). (A) Control group (B) low group (C) middle group (D) high group. Sy: synovium; Ca: Cartilage.

pinocytotic vesicles. It is reported that the intraarticular polymethylmethacrylate (PMMA), Zr, Co–Cr particles were mainly ingested by synovial fibroblasts, and induced the slightly increased synovial thickness [47]. The special character of small size and large surface area per mass render nanoparticles more biological activity. Some papers reported that the phagocytosed n-TiO_2 by monocytes, macrophages, embryo cells and neurons would result in the over production of ROS (O_2^- and OH) [27,48,49]. In the direct pathway, the intraarticular n-TiO_2 particles could induce fibroblast-like synoviocytes proliferation, lymphocytes and plasma cells infiltration and synovium hypertrophy (Fig. 10). Further, in the synovium of high TiO_2-exposed group, the significantly increased GSH-Px, GSH, GSSG, and SOD levels indicated that the oxidative damage was stimulated, which is the fact that the self-regulation of some enzymes and antioxidants in organisms. These antioxidative biomarkers were initiated to antagonize free radicals produced by phagocytosis, i.e. over production of H_2O_2 in the high group (Fig. 12). The free radicals can get across the cell membranes and attacks membrane phospholipids, resulting in phospholipid peroxidation (MDA elevation), which was also demonstrated in the synovium of rats by intraarticular TiO_2 nanoparticles exposure. However, the histological change of articular cartilage was not induced by the intraarticular TiO_2 nanoparticles (Fig. 9). This might be related with the native character of cartilage of no blood and lymph, which needs further study.

The proinflammatory cytokines TNF-α, IL-1β and IL-6 secreted by the activated macrophages, fibroblasts and neutrophils are the molecular messengers, which have been hypothesized to influence the tissue response to biomaterials [50]. According to the hierarchical oxidative stress hypothesis, the induction of antioxidative

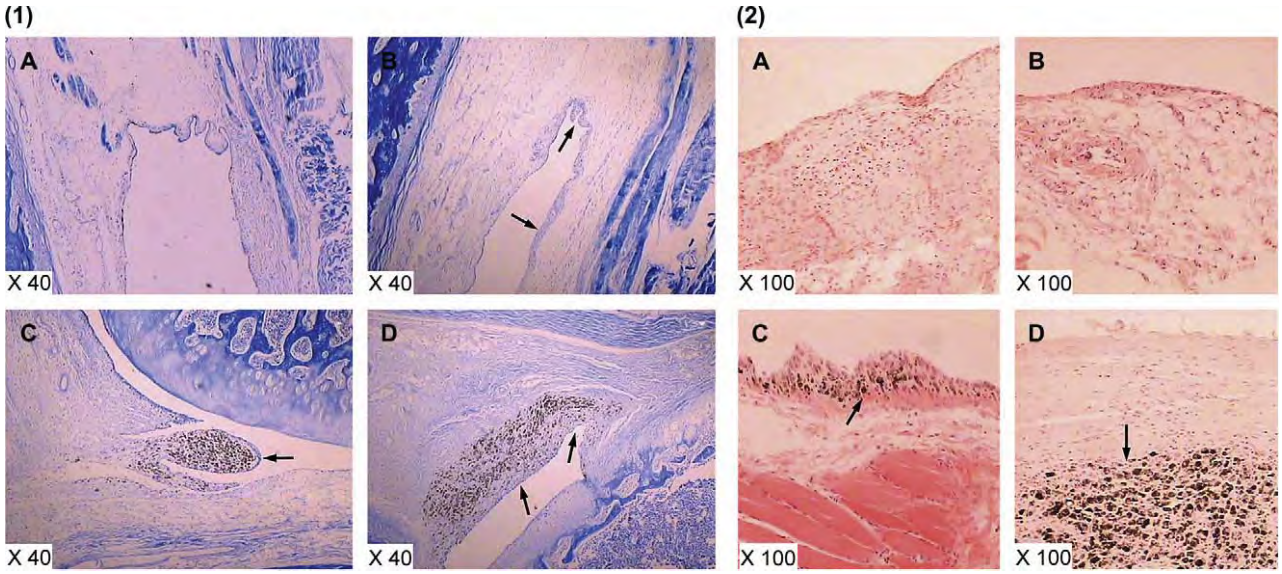

Fig. 10. Histopathological micrographs of knee joint (1) and synovium (2) of rats at 7 days post-exposure after intraarticular injection TiO_2 nanoparticles, showing the brown particulates deposition and the synovium hypertrophy. (A) Control group (B) low group (C) middle group (D) high group.

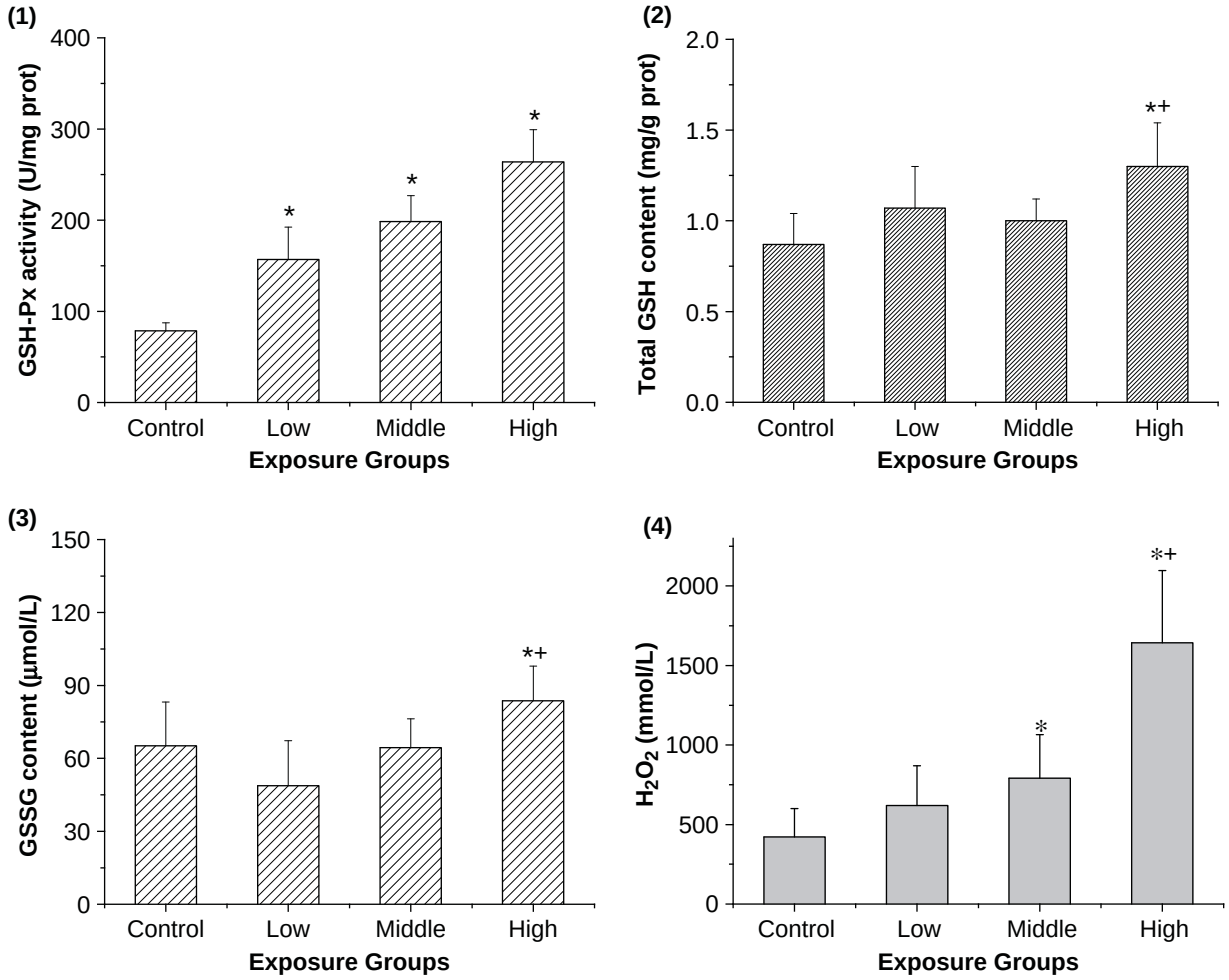

Fig. 11. Levels of GSH-Px (1), GSH (2), GSSG (3) and H_2O_2 (4) in the synovium of rats ($n = 7$) at 7 days post-exposure after intraarticular injection TiO_2 nanoparticles. $^{*}p < 0.05$ significantly different from the control group; $+p < 0.05$ significantly different from the low group.

enzymes and antioxidants is the lowest level of oxidative stress, whereas, the proinflammatory events through the activation of proinflammatory signaling cascades, a chronic long-lasting systemic autoimmunity, constitute the tier-2 stage for oxidative stress response [16,51]. From the tie-1 to tie-2 stage in the hierarchical oxidative stress, the induction or activation of proteins play a central role, e.g., TNF-α receptor 2. In the current study, the changes of TNF-α and IL-1β secretion were not determined in the joint lavage fluid and synovium homogenate in rat after n-TiO_2 particles exposure. We primarily estimated that the proinflammatory signaling cascades, e.g., mitogen-activated protein kinase (MAPK) and nuclear factor kB (NF-kB) cascade, were not

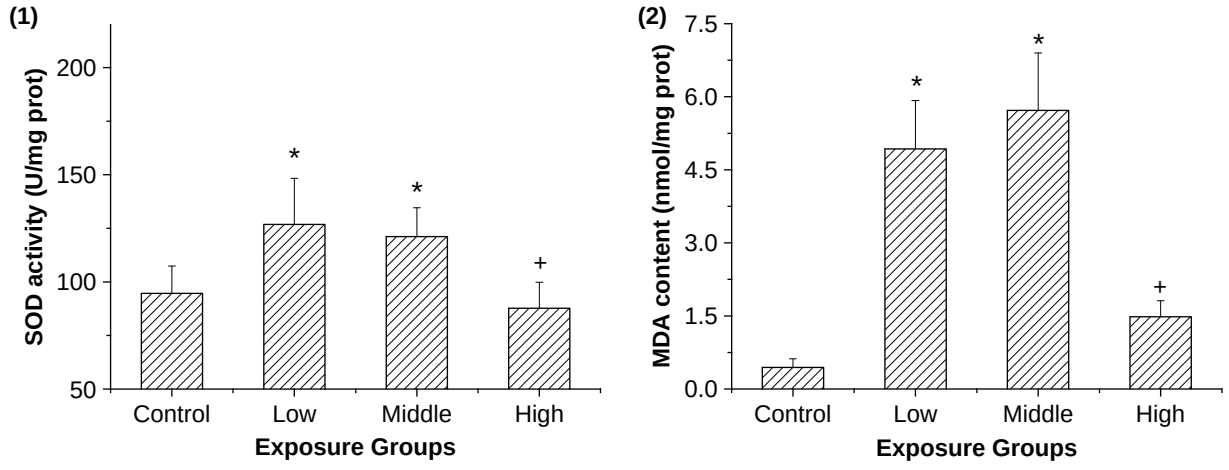

Fig. 12. Levels of SOD activity (1) and MDA content (2) in the synovium of rats ($n = 7$) at 7 days post-exposure after intraarticular injection TiO_2 nanoparticles. $^{*}p < 0.05$ significantly different from the control group; $+p < 0.05$ significantly different from the low group.

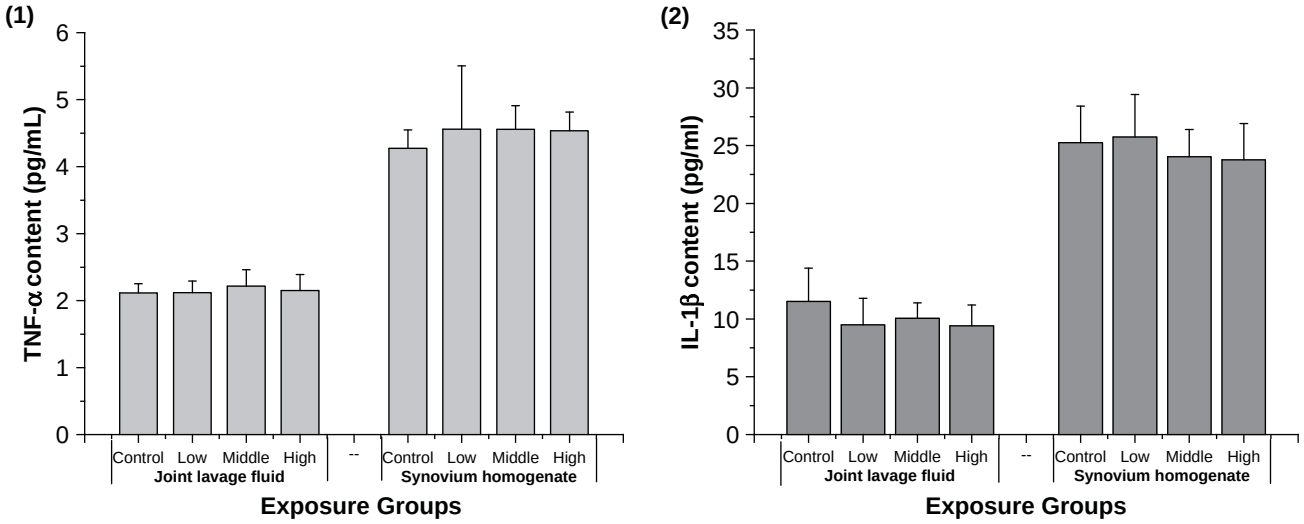

Fig. 13. TNF-α (1) and IL-1β (2) contents in the joint lavage fluid and synovium homogenate of rats ($n = 7$) at 7 days post-exposure after intraarticular injection TiO_2 nanoparticles.

enough activated or stimulated by intraarticular TiO_2 nanoparticles to result in cytokines production, though the significantly increased antioxidative enzymes and antioxidants were detected. Therefore, research upon cytokine signaling protein needs to be evaluated further.

5. Conclusion

In conclusion, we investigated the potential toxicological effect of intraarticular injected TiO_2 nanoparticles (anatase, red blood cells-like, purity >99.8%) on major organs and knee joints of rats at three different concentrations. The intraarticular TiO_2 nanoparticles with small aggregated size could be uptaken and disseminated to other tissues with the blood circulation. The slightly pathological changes of heart, lung, liver and knee joint were induced by the low-dose TiO_2, and severe pathological injury of major organs was induced in the rats after exposure to middle and high-dose TiO_2, which are consistent with the changes of serum biochemical parameters. In the knee joint, the aggregated large TiO_2 nanoparticles deposited and resulted in the synovium hypotrophy, lymphocytes and plasma cells infiltration, and fibroblast proliferation. The oxidative stress (upregulated GSH-Px, GSH, GSSG, and SOD) was activated and the lipid peroxidation was produced in the TiO_2-exposed synovium, but the proinflammatory cytokines (TNF-α and IL-1β) were not much interfered. The present results suggested that the wear particles retained in the knee joint have potential effects on biological function and the amounts of nanocoating on the traditional implants for joints should be controlled strictly.

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Appendix

Figures with essential colour discrimination. Figs. 4–10 of this article are difficult to interpret in black and white. The full colour images can be found in the on-line version, at doi:10.1016/j.biomaterials.2009.05.008.

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第 4 条，共 13 条
标题: Effect of Anatase TiO2 Nanoparticles on the Growth of RSC-364 Rat Synovial Cell
作者: Wang, JX (Wang, Jiangxue); Ma, JW (Ma, Jiawei); Dong, LM (Dong, Linmeng); Hou, Y (Hou, Ying); Jia, XL (Jia, Xiaoling); Niu, XF (Niu, Xufeng); Fan, YB (Fan, Yubo)
来源出版物: JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 卷: 13 期: 6 页: 3874-3879 DOI: 10.1166/jnn.2013.7145 出版年: JUN 2013
Web of Science 核心合集中的 "被引频次": 8
被引频次合计: 8
入藏号: WOS:000320205400017
PubMed ID: 23862421
地址: [Wang, Jiangxue; Ma, Jiawei; Dong, Linmeng; Hou, Ying; Jia, Xiaoling; Niu, Xufeng; Fan, Yubo] Beihang Univ, Sch Biol Sci & Med Engn, Key Lab Biomech & Mechanobiol,

Minist Educ, Beijing 100191, Peoples R China.
通讯作者地址: Fan, YB (通讯作者),Beihang Univ, Sch Biol Sci & Med Engn, Key Lab Biomech & Mechanobiol, Minist Educ, Beijing 100191, Peoples R China.
IDS 号: 161PI
ISSN: 1533-4880
eISSN: 1533-4899
第 5 条，共 13 条
标题: Titanium Dioxide Nanoparticles Induced Proinflammation of Primary Cultured Cardiac Myocytes of Rat
共同一作
作者: Song, W (Song, Wei); Wang, JX (Wang, Jiangxue); Liu, ML (Liu, Meili); Li, P (Li, Ping); Zhou, G (Zhou, Gang); Li, Z (Li, Zhou); Fan, YB (Fan, Yubo)
来源出版物: JOURNAL OF NANOMATERIALS 文献号: 349140 DOI: 10.1155/2013/349140 出版年: 2013
Web of Science 核心合集中的 "被引频次": 1
被引频次合计: 1
入藏号: WOS:000325918800001
地址: [Song, Wei; Wang, Jiangxue; Liu, Meili; Li, Ping; Zhou, Gang; Li, Zhou; Fan, Yubo] Beihang Univ, Sch Biol Sci & Med Engn, Minist Educ, Key Lab Biomech & Mechanobiol, Beijing 100191, Peoples R China.
[Song, Wei; Wang, Jiangxue; Fan, Yubo] Beihang Univ Shenzhen, Res Inst, Shenzhen 518057, Peoples R China.
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IDS 号: 238CR
ISSN: 1687-4110
eISSN: 1687-4129
第 6 条，共 13 条
标题: Evaluation on Cartilage Morphology after Intra-Articular Injection of Titanium Dioxide Nanoparticles in Rats
作者: Wang, JX (Wang, Jiangxue); Gao, Y (Gao, Yu); Hou, Y (Hou, Ying); Zhao, F (Zhao, Feng); Pu, F (Pu, Fang); Liu, XY (Liu, Xiaoyu); Wu, ZH (Wu, Zhihong); Fan, YB (Fan, Yubo)
来源出版物: JOURNAL OF NANOMATERIALS 文献号: 452767 DOI: 10.1155/2012/452767 出版年: 2012

Web of Science 核心合集中的 "被引频次": 2
被引频次合计: 2
入藏号: WOS:000302695700001
地址: [Wang, Jiangxue; Gao, Yu; Hou, Ying; Zhao, Feng; Pu, Fang; Liu, Xiaoyu; Fan, Yubo] Beihang Univ, Key Lab Biomech & Mechanobiol, Minist Educ, Sch Biol Sci & Med Engn, Beijing 100191, Peoples R China.
[Wu, Zhihong] Beijing Union Med Coll Hosp, Dept Orthoped, Beijing 100730, Peoples R China.
通讯作者地址: Fan, YB (通讯作者),Beihang Univ, Key Lab Biomech & Mechanobiol, Minist Educ, Sch Biol Sci & Med Engn, Beijing 100191, Peoples R China.
电子邮件地址: yubofan@buaa.edu.cn
IDS 号: 924MK
ISSN: 1687-4110
第 7 条，共 13 条
标题: Repair of Bone Defect in Femoral Condyle Using Microencapsulated Chitosan, Nanohydroxyapatite/Collagen and Poly(L-Lactide)-Based Microsphere-Scaffold Delivery System
作者: Niu, XF (Niu, Xufeng); Fan, YB (Fan, Yubo); Liu, XH (Liu, Xinhui); Li, XM (Li, Xiaoming); Li, P (Li, Ping); Wang, JX (Wang, Jiangxue); Sha, ZY (Sha, Ziyi); Feng, QL (Feng, Qingling)
来源出版物: ARTIFICIAL ORGANS 卷: 35 期: 7 页: E119-E128 DOI: 10.1111/j.1525-1594.2011.01274.x 出版年: JUL 2011
Web of Science 核心合集中的 "被引频次": 15
被引频次合计: 19
入藏号: WOS:000292651100001
PubMed ID: 21658081
地址: [Niu, Xufeng; Feng, Qingling] Tsinghua Univ, Dept Mat Sci & Engn, Adv Mat Lab, Beijing 100084, Peoples R China.
[Niu, Xufeng; Fan, Yubo; Li, Xiaoming; Li, Ping; Wang, Jiangxue] Beihang Univ, Sch Biol Sci & Med Engn, Key Lab Biomech & Mechanobiol, Minist Educ, Beijing, Peoples R China.
[Liu, Xinhui; Sha, Ziyi] Hebei Med Univ, Hosp 1, Shijiazhuang, Peoples R China.
通讯作者地址: Feng, QL (通讯作者),Tsinghua Univ, Dept Mat Sci & Engn, Adv Mat Lab, Beijing 100084, Peoples R China.
电子邮件地址: biomater@mail.tsinghua.edu.cn

IDS 号: 791FU
ISSN: 0160-564X
第 8 条，共 13 条
标题: Potential Health Impact on Mice after Nasal Instillation of Nano-Sized Copper Particles and Their Translocation in Mice
作者: Liu, Y (Liu, Yang); Gao, YX (Gao, Yuxi); Zhang, LL (Zhang, Lili); Wang, TC (Wang, Tiancheng); Wang, JX (Wang, Jiangxue); Jiao, F (Jiao, Fang); Li, W (Li, Wei); Liu, Y (Liu, Ying); Li, YF (Li, Yufeng); Li, B (Li, Bai); Chai, ZF (Chai, Zhifang); Wu, G (Wu, Gang); Chen, CY (Chen, Chunying)
来源出版物: JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 卷: 9 期: 11 页: 6335-6343 DOI: 10.1166/jnn.2009.1320 出版年: NOV 2009
Web of Science 核心合集中的 "被引频次": 33
被引频次合计: 35
入藏号: WOS:000270471100011
PubMed ID: 19908531
地址: [Liu, Yang; Wu, Gang] Baotou Med Coll, Dept Basic Med, Baotou 014010, Peoples R China.
[Chai, Zhifang] Shanghai Univ, Inst Nanochem & Nanobiol, Shanghai 200444, Peoples R China.
[Wang, Tiancheng] Peking Univ, Hosp 3, Dept Clin Lab Med, Beijing 100083, Peoples R China.
[Liu, Yang; Gao, Yuxi; Zhang, Lili; Wang, Jiangxue; Jiao, Fang; Li, Wei; Liu, Ying; Li, Yufeng; Li, Bai; Chai, Zhifang; Chen, Chunying] Natl Ctr Nanosci & Technol, Beijing 100190, Peoples R China.
[Liu, Yang; Gao, Yuxi; Zhang, Lili; Wang, Jiangxue; Jiao, Fang; Li, Wei; Liu, Ying; Li, Yufeng; Li, Bai; Chai, Zhifang; Chen, Chunying] Chinese Acad Sci, Inst High Energy Phys, Key Lab Nucl Analyt Tech, Beijing 100049, Peoples R China.
[Liu, Yang; Gao, Yuxi; Zhang, Lili; Wang, Jiangxue; Jiao, Fang; Li, Wei; Liu, Ying; Li, Yufeng; Li, Bai; Chai, Zhifang; Chen, Chunying] Chinese Acad Sci, Lab Bioenvironm Effects Nanomat & Nanosafety, Beijing 100049, Peoples R China.
通讯作者地址: Wu, G (通讯作者),Baotou Med Coll, Dept Basic Med, Baotou 014010, Peoples R China.
IDS 号: 502OZ
ISSN: 1533-4880
第 9 条，共 13 条
标题: TiO2 nanoparticles translocation and potential toxicological effect in rats after

intraarticular injection

作者: Wang, JX (Wang, Jiang-Xue); Fan, YB (Fan, Yu-Bo); Gao, Y (Gao, Yu); Hu, QH (Hu, Qing-Hua); Wang, TC (Wang, Tian-Cheng)

来源出版物: BIOMATERIALS 卷: 30 期: 27 页: 4590-4600 DOI: 10.1016/j.biomaterials.2009.05.008 出版年: SEP 2009

Web of Science 核心合集中的 "被引频次": 53

被引频次合计: 56

入藏号: WOS:000269330400018

PubMed ID: 19500841

地址: [Wang, Jiang-Xue; Fan, Yu-Bo; Gao, Yu; Hu, Qing-Hua] Beihang Univ, Sch Biol Sci & Med Engn, Beijing 100191, Peoples R China.

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IDS 号: 488DX

ISSN: 0142-9612

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第 10 条，共 13 条

标题: Potential neurological lesion after nasal instillation of TiO2 nanoparticles in the anatase and rutile crystal phases

作者: Wang, JX (Wang, Jiangxue); Chen, CY (Chen, Chunying); Liu, Y (Liu, Ying); Jiao, F (Jiao, Fang); Li, W (Li, Wei); Lao, F (Lao, Fang); Li, YF (Li, Yufeng); Li, B (Li, Bai); Ge, CC (Ge, Cuicui); Zhou, GQ (Zhou, Guoqiang); Gao, YX (Gao, Yuxi); Zhao, YL (Zhao, Yuliang); Chai, ZF (Chai, Zhifang)

来源出版物: TOXICOLOGY LETTERS 卷: 183 期: 1-3 页: 72-80 DOI: 10.1016/j.toxlet.2008.10.001 出版年: DEC 15 2008

Web of Science 核心合集中的 "被引频次": 161

被引频次合计: 176

入藏号: WOS:000262053000010

PubMed ID: 18992307

地址: [Chen, Chunying] Chinese Acad Sci, NCNST, Lab Bioenvironm Effects Nanomat & Nanosafety, Beijing 100049, Peoples R China.

[Wang, Jiangxue; Chen, Chunying; Liu, Ying; Jiao, Fang; Li, Wei; Lao, Fang; Li, Yufeng;

Li, Bai; Ge, Cuicui; Zhou, Guoqiang; Gao, Yuxi; Zhao, Yuliang; Chai, Zhifang] Chinese Acad Sci, Inst High Energy Phys, Key Lab Nucl Analyt Tech, Beijing 100049, Peoples R China.

通讯作者地址: Chen, CY (通讯作者),Chinese Acad Sci, NCNST, Lab Bioenvironm Effects Nanomat & Nanosafety, 11 1st North St, Beijing 100049, Peoples R China.

电子邮件地址: chenchy@nanoctr.cn; zhaoyuliang@ihep.ac.cn

IDS 号: 388XG

ISSN: 0378-4274

eISSN: 1879-3169

第 11 条，共 13 条

标题: Time-dependent translocation and potential impairment on central nervous system by intranasally instilled TiO2 nanoparticles

作者: Wang, JX (Wang, Jiangxue); Liu, Y (Liu, Ying); Jiao, F (Jiao, Fang); Lao, F (Lao, Fang); Li, W (Li, Wei); Gu, YQ (Gu, Yiqun); Li, YF (Li, Yufeng); Ge, CC (Ge, Cuicui); Zhou, GQ (Zhou, Guoqiang); Li, B (Li, Bai); Zhao, YL (Zhao, Yuliang); Chai, ZF (Chai, Zhifang); Chen, CY (Chen, Chunying)

来源出版物: TOXICOLOGY 卷: 254 期: 1-2 页: 82-90 DOI: 10.1016/j.tox.2008.09.014 出版年: DEC 5 2008

Web of Science 核心合集中的 "被引频次": 181

被引频次合计: 200

入藏号: WOS:000261837100010

PubMed ID: 18929619

地址: [Wang, Jiangxue; Liu, Ying; Jiao, Fang; Lao, Fang; Li, Wei; Li, Yufeng; Ge, Cuicui; Zhou, Guoqiang; Li, Bai; Zhao, Yuliang; Chai, Zhifang; Chen, Chunying] Chinese Acad Sci, Inst High Energy Phys, Lab Bioenvirom Effects Nanomat & Nanosafety, Beijing 100049, Peoples R China.

[Wang, Jiangxue; Liu, Ying; Jiao, Fang; Lao, Fang; Li, Wei; Li, Yufeng; Ge, Cuicui; Zhou, Guoqiang; Li, Bai; Zhao, Yuliang; Chai, Zhifang; Chen, Chunying] Chinese Acad Sci, Inst High Energy Phys, Key Lab Nucl Analyt Tech, Beijing 100049, Peoples R China.

[Wang, Jiangxue; Liu, Ying; Jiao, Fang; Lao, Fang; Li, Wei; Li, Yufeng; Ge, Cuicui; Zhou, Guoqiang; Li, Bai; Zhao, Yuliang; Chai, Zhifang; Chen, Chunying] Natl Ctr Nanosci & Technol, Beijing 100190, Peoples R China.

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通讯作者地址: Zhao, YL (通讯作者),Chinese Acad Sci, Inst High Energy Phys, Lab Bioenvirom Effects Nanomat, Beijing 100049, Peoples R China.

电子邮件地址: zhaoyuliang@ihep.ac.cn; chenchy@nanoctr.cn

IDS 号: 385TS
ISSN: 0300-483X
第 12 条，共 13 条
标题: BIOLOGICAL EFFECT OF INTRANASALLY INSTILLED TITANIUM DIOXIDE NANOPARTICLES ON FEMALE MICE
作者: Wang, JX (Wang, Jiangxue); Li, YF (Li, Yufeng); Li, W (Li, Wei); Chen, CY (Chen, Chunying); Li, B (Li, Bai); Zhao, YL (Zhao, Yuliang)
来源出版物: NANO 卷: 3 期: 4 页: 279-285 出版年: AUG 2008
Web of Science 核心合集中的 "被引频次": 7
被引频次合计: 8
入藏号: WOS:000263625700014
会议名称: 3rd International Symposium on Nanotechnology in Environmental Protection and Pollution (ISNEPP 2007)
会议日期: DEC, 2007
会议地点: Ft Lauderdale, FL
电子邮件地址: tswjx126@yahoo.com.cn; liyf@ihep.ac.cn; liw@ihep.ac.cn; chenchy@nanoctr.cn; libai@ihep.ac.cn; zhaoyuliang@ihep.ac.cn
IDS 号: 411CN
ISSN: 1793-2920
第 13 条，共 13 条
标题: Scalp hair as a biomarker in environmental and occupational mercury exposed populations: Suitable or not?
作者: Li, YF (Li, Yu-Feng); Chen, CY (Chen, Chunying); Li, B (Li, Bai); Wang, JX (Wang, Jiangxue); Gao, YX (Gao, Yuxi); Zhao, YL (Zhao, Yuliang); Chai, ZF (Chai, Zhifang)
来源出版物: ENVIRONMENTAL RESEARCH 卷: 107 期: 1 页: 39-44 DOI: 10.1016/j.envres.2007.07.003 出版年: MAY 2008
Web of Science 核心合集中的 "被引频次": 17
被引频次合计: 18
入藏号: WOS:000256137600006
PubMed ID: 17706190
会议名称: 8th International Conference on Mercury as a Global Pollutant
会议日期: AUG 06-11, 2006
会议地点: Madison, WI
地址: [Li, Yu-Feng; Chen, Chunying; Li, Bai; Wang, Jiangxue; Gao, Yuxi; Zhao, Yuliang;

Chai, Zhifang] Chinese Acad Sci, Inst High Energy Phys, Key Lab Nucl Analyt Tech, Beijing 100049, Peoples R China.
[Li, Yu-Feng; Wang, Jiangxue] Grad Univ, Chinese Acad Sci, Beijing 100049, Peoples R China.
[Chen, Chunying] Natl Ctr Nanosci & Nanotech China NCNST, Beijing 100080, Peoples R China.
通讯作者地址: Chen, CY (通讯作者),Chinese Acad Sci, Inst High Energy Phys, Key Lab Nucl Analyt Tech, Beijing 100049, Peoples R China.
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ISSN: 0013-9351

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经检索 Thomson Reuters 官方网站的 Science Citation Index（SCI）来源期刊列表（http://science.thomsonreuters.com/cgi-bin/jrnlst/jloptions.cgi?PC=K），下列 7 种期刊为 SCI 来源期刊：

检索时间为 2016 年 5 月 25 日。

特此证明！

证明人（签字）：

证明单位（盖章）：北京航空航天大学图书馆

2016 年 5 月 25 日

附件：

ENVIRONMENTAL RESEARCH

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JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY

Monthly ISSN: 1533-4880

AMER SCIENTIFIC PUBLISHERS, 26650 THE OLD RD, STE 208, VALENCIA, USA, CA, 91381-0751

INTERNATIONAL JOURNAL OF ARTIFICIAL ORGANS

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TOXICOLOGY

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SCIE 来源期刊检索证明

经检索 Thomson Reuters 官方网站的 Science Citation Index Expanded（SCIE）来源期刊列表（http://ip-science.thomsonreuters.com/cgi-bin/jrnlst/jloptions.cgi?PC=D），下列 4 种期刊为 SCIE 来源期刊。

检索结果见附件（共 1 页）。

检索时间为 2016 年 5 月 25 日。

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证明人（签字）：

证明单位（盖章）：北京航空航天大学图书馆

2016 年 5 月 25 日

附件：

JOURNAL OF NANOMATERIALS

Irregular ISSN: 1687-4110

HINDAWI PUBLISHING CORP, 410 PARK AVENUE, 15TH FLOOR, #287 PMB, NEW YORK, USA, NY, 10022

INTERNATIONAL JOURNAL OF MOLECULAR SCIENCES

Monthly ISSN: 1422-0067

MDPI AG, POSTFACH, BASEL, SWITZERLAND, CH-4005

INTERNATIONAL JOURNAL OF ELECTROCHEMICAL SCIENCE

Monthly ISSN: 1452-3981

ESG, BORIVOJA STEVANOVICA 25-7, BELGRADE, SERBIA, 11000

JOURNAL OF NANOPARTICLE RESEARCH

Irregular ISSN: 1388-0764

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期刊影响因子证明

经检索“期刊引证报告（Journal Citation Reports）”数据库，下列 11 种期刊的影响因子见附件。

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特此证明！

证明人（签字）：

证明单位（盖章）：北京航空航天大学图书馆

2016 年 5 月 25 日

附件：

ENVIRONMENTAL RESEARCH

影响因子
4.373 4.234
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JCR® 类别	类别中的排序	JCR 分区
ENVIRONMENTAL SCIENCES	15/223	Q1
PUBLIC, ENVIRONMENTAL & OCCUPATIONAL HEALTH 在第 SCIE 版中	15/165	Q1

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12.881 14.412
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CHEMISTRY, MULTIDISCIPLINARY	9/157	Q1
CHEMISTRY, PHYSICAL	8/139	Q1
MATERIALS SCIENCE, MULTIDISCIPLINARY	10/260	Q1
NANOSCIENCE & NANOTECHNOLOGY	5/80	Q1

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1.644 1.798
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JCR® 类别	类别中的排序	JCR 分区
MATERIALS SCIENCE, MULTIDISCIPLINARY	122/260	Q2
NANOSCIENCE & NANOTECHNOLOGY	48/80	Q3

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JCR® 类别	类别中的排序	JCR 分区
CHEMISTRY, MULTIDISCIPLINARY	74/157	Q2
MATERIALS SCIENCE, MULTIDISCIPLINARY	134/260	Q3
NANOSCIENCE & NANOTECHNOLOGY	49/80	Q3
PHYSICS, APPLIED	74/144	Q3
PHYSICS, CONDENSED MATTER	41/67	Q3

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3.621 3.81
2014 5 年

JCR® 类别	类别中的排序	JCR 分区
PHARMACOLOGY & PHARMACY	58/255	Q1
TOXICOLOGY	16/88	Q1

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3.262 3.545
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JCR® 类别	类别中的排序	JCR 分区
TOXICOLOGY	21/88	Q1

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2014 5 年

JCR® 类别	类别中的排序	JCR 分区
ENGINEERING, BIOMEDICAL	2/76	Q1
MATERIALS SCIENCE, BIOMATERIALS	1/33	Q1

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BIOCHEMISTRY & MOLECULAR BIOLOGY	134/290	Q2
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ENGINEERING, BIOMEDICAL	31/76	Q2
TRANSPLANTATION	15/25	Q3

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NANOSCIENCE & NANOTECHNOLOGY	65/80	Q4
PHYSICS, APPLIED	99/144	Q3

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ISSN: 1793-2920

北京航空航天大學

文献收录检索证明

作者姓名：王江雪 (Wang Jiangxue)

经检索“网络版工程索引（EI Compendex）”数据库，该作者发表的论文（2013），被收录 2 篇。

检索结果见附件，共 2 页。

检索时间为 2016 年 5 月 25 日

特此证明！

证明人（签字）：

证明单位（盖章）：北京航空航天大学图书馆

2016 年 5 月 25 日

附件：

1. Influence of TiO2 nanoparticles on glutathione in rat synovial cell line RSC-364

Accession number: 20131616209441

Authors: Wang, Jiangxue (1); Hou, Ying (1); Dong, Linmeng (1); Niu, Xufeng (1); Fan, Yubo (1)

Author affiliation: (1) Key Laboratory for Biomechanics and Mechanobiology of Ministry of Education, School of Biological Science and Medical Engineering, Beihang University, Beijing, China

Corresponding author: Fan, Y.(yubofan@buaa.edu.cn)

Source title: IFMBE Proceedings

Abbreviated source title: IFMBE Proc.

Volume: 39 IFMBE

Monograph title: World Congress on Medical Physics and Biomedical Engineering

Issue date: 2013

Publication year: 2013

Pages: 75-78

Language: English

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ISBN-13: 9783642293047

Document type: Conference article (CA)

Conference name: World Congress on Medical Physics and Biomedical Engineering

Conference date: May 26, 2012 - May 31, 2012

Conference location: Beijing, China

Conference code: 96476

Publisher: Springer Verlag, Tiergartenstrasse 17, Heidelberg, D-69121, Germany

2. Preparation of chitosan/poly(L-lactide) porous composite scaffolds

Accession number: 20131616209443

Authors: Chen, Pin (1); Niu, Xufeng (1, 2); She, Zhending (3); Zhou, Gang (1); Tan, Rongwei (3); Wang, Jiangxue (1); Fan, Yubo (1, 2)

Author affiliation: (1) Key Laboratory for Biomechanics and Mechanobiology of Ministry of Education, School of Biological Science and Medical Engineering, Beihang University, Beijing 100191, China; (2) Research Institute of Beihang University in Shenzhen, Shenzhen 518057, China; (3) Key Laboratory of Biomedical Materials and Implants, Research Institute of Tsinghua University in Shenzhen, Shenzhen 518057, China

Corresponding author: Niu, X.(nxf@buaa.edu.cn)
Source title: IFMBE Proceedings
Abbreviated source title: IFMBE Proc.
Volume: 39 IFMBE
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Issue date: 2013
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Language: English
ISSN: 16800737
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Document type: Conference article (CA)
Conference name: World Congress on Medical Physics and Biomedical Engineering
Conference date: May 26, 2012 - May 31, 2012
Conference location: Beijing, China
Conference code: 96476
Publisher: Springer Verlag, Tiergartenstrasse 17, Heidelberg, D-69121, Germany

北京航空航天大學 图书馆

EI Compendex 来源期刊检索证明

经检索“Elsevier”官方网站的来源期刊列表（http://www.elsevier.com/online-tools/engineering-village/contentdatabase-overview），下列 1 种期刊为 EI Compendex 来源期刊：

1.IFMBE Proceedings

ISSN：16800737

检索时间为 2015 年 5 月 25 日。

特此证明！

证明人（签字）：

证明单位（盖章）：北京航空航天大学图书馆

2015 年 5 月 25 日

北京航空航天大學 LIBRARY BEIHANG UNIVERSITY 图书馆

中文核心期刊检索证明

经检索《中文核心期刊要目总览（2014 年版）》（朱强、何峻、蔡蓉华主编，北京大学出版社，ISBN: 978-7-301-26189-7），附件中 4 种期刊为核心期刊。

核心期刊版次见附件，共 1 页。

检索时间为 2016 年 5 月 25 日。

特此证明！

证明人（签字）：

证明单位（盖章）：北京航空航天大学图书馆

2016 年 5 月 25 日

附件：

1.【期刊名称】生态毒理学报
【ISSN】1673-5897
【核心期刊版次】2011/2014

2.【期刊名称】生物医学工程研究
【ISSN】1672-6278
【核心期刊版次】2014

3.【期刊名称】医用生物力学
【ISSN】1004-7220
【核心期刊版次】2011/2014

3.【期刊名称】中国药理学与毒理学杂志
【ISSN】1000-3002
【核心期刊版次】1992/1996/2000/2004/2008/2011/2014

北京航空航天大學 图书馆

文献引用检索证明

作者姓名：王江雪 (Wang Jiangxue)

经检索“Web of Science 引文索引数据库”，该作者发表的 12 篇论文，共被他引 410 次(in SCIE)。

（他引定义：引用文献不包含被引文献的任意作者的引用视为他引。）

检索结果见附件，共 91 页。

检索时间为 2016 年 5 月 25 日。

特此证明！

证明人（签字）：

证明单位（盖章）：北京航空航天大学图书馆

2016 年 5 月 25 日

附件：

第 1 条，共 12 条

标题: Implantable Self-Powered Low-Level Laser Cure System for Mouse Embryonic Osteoblasts Proliferation and Differentiation

作者: Tang, W (Tang, Wei); Tian, JJ (Tian, Jingjing); Zheng, Q (Zheng, Qiang); Yan, L (Yan, Lin); Wang, JX (Wang, Jiangxue); Li, Z (Li, Zhou); Wang, ZL (Wang, Zhong Lin)

来源出版物: ACS NANO 卷: 9 期: 8 页: 7867-7873 DOI: 10.1021/acsnano.5b03567 出版年: AUG 2015

Web of Science 核心合集中的 "被引频次": 2

第 1 条，共 2 条

标题: Hybrid nanogenerators based on triboelectrification of a dielectric composite made of lead-free ZnSnO3 nanocubes

作者: Wang, G (Wang, Guo); Xi, Y (Xi, Yi); Xuan, HX (Xuan, Haixia); Liu, RC (Liu, Ruchuan); Chen, X (Chen, Xi); Cheng, L (Cheng, Lu)

来源出版物: NANO ENERGY 卷: 18 页: 28-36 DOI: 10.1016/j.nanoen.2015.09.012 出版年: NOV 2015

第 2 条，共 2 条

标题: Wearable and Implantable Mechanical Energy Harvesters for Self-Powered Biomedical Systems

作者: Hinchet, R (Hinchet, Ronan); Kim, SW (Kim, Sang-Woo)

来源出版物: ACS NANO 卷: 9 期: 8 页: 7742-7745 DOI: 10.1021/acsnano.5b04855 出版年: AUG 2015

第 2 条，共 12 条

标题: Lung Injury Induced by TiO2 Nanoparticles Depends on Their Structural Features: Size, Shape, Crystal Phases, and Surface Coating

作者: Wang, JX (Wang, Jiangxue); Fan, YB (Fan, Yubo)

来源出版物: INTERNATIONAL JOURNAL OF MOLECULAR SCIENCES 卷: 15 期: 12 页: 22258-22278 DOI: 10.3390/ijms151222258 出版年: DEC 2014

Web of Science 核心合集中的 "被引频次": 9

第 1 条，共 9 条

标题: Respiratory tract toxicity of titanium dioxide nanoparticles and multi-walled carbon nanotubes on mice after intranasal exposure

作者: Sukwong, P (Sukwong, Patinya); Somkid, K (Somkid, Koravit); Kongseng, S (Kongseng, Supunsa); Pissuwan, D (Pissuwan, Dakrong); Yoovathaworn, K (Yoovathaworn, Krongtong)

来源出版物: MICRO & NANO LETTERS 卷: 11 期: 4 页: 183-187 DOI: 10.1049/mnl.2015.0523 出版年: APR 2016

第 2 条，共 9 条

标题: Environmental risk induced by TiO2 dispersions in waters and sediments: a case study

作者: Lettino, A (Lettino, Antonio); Belviso, C (Belviso, Claudia); Cavalcante, F (Cavalcante, Francesco); Fiore, S (Fiore, Saverio)

来源出版物: ENVIRONMENTAL GEOCHEMISTRY AND HEALTH 卷: 38 期: 1 页: 73-84 DOI: 10.1007/s10653-015-9685-0 出版年: FEB 2016

第 3 条，共 9 条

标题: Titanium Dioxide Nanoparticles: A Risk for Human Health?

作者: Grande, F (Grande, Fedora); Tucci, P (Tucci, Paola)

来源出版物: MINI-REVIEWS IN MEDICINAL CHEMISTRY 卷: 16 期: 9 页: 762-769 DOI: 10.2174/1389557516666160321114341 出版年: 2016

第 4 条，共 9 条

标题: Morphological and Physicochemical Characterization of Agglomerates of Titanium Dioxide Nanoparticles in Cell Culture Media

作者: Freyre-Fonseca, V (Freyre-Fonseca, Veronica); Tellez-Medina, DI (Tellez-Medina, Dario I.); Medina-Reyes, EI (Medina-Reyes, Estefany I.); Cornejo-Mazon, M (Cornejo-Mazon, Maribel); Lopez-Villegas, EO (Lopez-Villegas, Edgar O.); Alamilla-Beltran, L (Alamilla-Beltran, Liliana); Ocotlan-Flores, J (Ocotlan-Flores, Jose); Chirino, YI (Chirino, Yolanda I.); Gutierrez-Lopez, GF (Gutierrez-Lopez, Gustavo F.)

来源出版物: JOURNAL OF NANOMATERIALS 文献号: 5937932 DOI: 10.1155/2016/5937932 出版年: 2016

第 5 条，共 9 条

标题: When 1+1 > 2: Nanostructured composites for hard tissue engineering applications

作者: Uskokovic, V (Uskokovic, Vuk)

来源出版物: MATERIALS SCIENCE & ENGINEERING C-MATERIALS FOR BIOLOGICAL APPLICATIONS 卷: 57 页: 434-451 DOI: 10.1016/j.msec.2015.07.050 出版年: DEC 1 2015

第 6 条，共 9 条

标题: Inhalation of titanium dioxide induces endoplasmic reticulum stress-mediated autophagy and inflammation in mice

作者: Yu, KN (Yu, Kyeong-Nam); Sung, JH (Sung, Jae Hyuck); Lee, S (Lee, Somin); Kim, JE (Kim, Ji-Eun); Kim, S (Kim, Sanghwa); Cho, WY (Cho, Won-Young); Lee, AY (Lee, Ah Young); Park, SJ (Park, Soo Jin); Lim, J (Lim, Joohyun); Park, C (Park, Changhoon); Chae, C (Chae, Chanhee); Lee, JK (Lee, Jin Kyu); Lee, J (Lee, Jinkyu); Kim, JS (Kim, Jun-Sung); Cho, MH (Cho, Myung-Haing)

来源出版物: FOOD AND CHEMICAL TOXICOLOGY 卷: 85 页: 106-113 DOI: 10.1016/j.fct.2015.08.001 出版年: NOV 2015

第 7 条，共 9 条

标题: Difference in polystyrene oxo-biodegradation behavior between copper phthalocyanine modified TiO2 and ZnO paint photocatalyst systems

作者: Nakatani, H (Nakatani, Hisayuki); Motokucho, S (Motokucho, Suguru); Miyazaki, K (Miyazaki, Kensuke)

来源出版物: POLYMER DEGRADATION AND STABILITY 卷: 120 页: 1-9 DOI: 10.1016/j.polymdegradstab.2015.06.002 出版年: OCT 2015

第 8 条，共 9 条

标题: Nanotoxicology of Metal Oxide Nanoparticles

作者: Seabra, AB (Seabra, Amedea B.); Duran, N (Duran, Nelson)

来源出版物: METALS 卷: 5 期: 2 页: 934-975 DOI: 10.3390/met5020934 出版年: JUN 2015

第 9 条，共 9 条

标题: A decision-making framework for the grouping and testing of nanomaterials (DF4nanoGrouping)

作者: Arts, JHE (Arts, Josje H. E.); Hadi, M (Hadi, Mackenzie); Irfan, MA (Irfan, Muhammad-Adeel); Keene, AM (Keene, Athena M.); Kreiling, R (Kreiling, Reinhard); Lyon, D (Lyon, Delina); Maier, M (Maier, Monika); Michel, K (Michel, Karin); Petry, T (Petry, Thomas); Sauer, UG (Sauer, Ursula G.); Warheit, D (Warheit, David); Wiench, K (Wiench, Karin); Wohlleben, W (Wohlleben, Wendel); Landsiedel, R (Landsiedel, Robert)

来源出版物: REGULATORY TOXICOLOGY AND PHARMACOLOGY 卷: 71 期: 2 页: S1-S27 DOI: 10.1016/j.yrtph.2015.03.007 增刊: 1 出版年: MAR 15 2015

第 3 条，共 12 条

标题: Effect of Anatase TiO2 Nanoparticles on the Growth of RSC-364 Rat Synovial Cell

作者: Wang, JX (Wang, Jiangxue); Ma, JW (Ma, Jiawei); Dong, LM (Dong, Linmeng); Hou, Y (Hou, Ying); Jia, XL (Jia, Xiaoling); Niu, XF (Niu, Xufeng); Fan, YB (Fan, Yubo)

来源出版物: JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 卷: 13 期: 6 页: 3874-3879 DOI: 10.1166/jnn.2013.7145 出版年: JUN 2013

Web of Science 核心合集中的 "被引频次": 9

第 1 条，共 9 条

标题: Chlorogenic acid induces apoptosis to inhibit inflammatory proliferation of IL-6-induced fibroblast-like synoviocytes through modulating the activation of JAK/STAT and NF-kappa B signaling pathways

作者: Lou, LX (Lou, Lixia); Zhou, JW (Zhou, Jingwei); Liu, YJ (Liu, Yujun); Wei, Y (Wei, Yi); Zhao, JL (Zhao, Jiuli); Deng, JG (Deng, Jiagang); Dong, B (Dong, Bin); Zhu, LQ (Zhu, Lingqun); Wu, AM (Wu, Aiming); Yang, YX (Yang, Yingxi); Chai, LM (Chai, Limin)

来源出版物: EXPERIMENTAL AND THERAPEUTIC MEDICINE 卷: 11 期: 5 页: 2054-2060 DOI: 10.3892/etm.2016.3136 出版年: MAY 2016

第 2 条，共 9 条

标题: The Effect of Artificial Ageing on Cytotoxicity of Nano-TiO2 Silicone Elastomer

作者: Wang, LL (Wang, Linlin); Hu, C (Hu, Chen); Liu, Q (Liu, Qi); Shao, LQ (Shao, Longquan)

来源出版物: JOURNAL OF BIOMATERIALS AND TISSUE ENGINEERING 卷: 5 期: 12 页: 996-1002 DOI: 10.1166/jbt.2015.1408 出版年: DEC 2015

第 3 条，共 9 条

标题: Chlorogenic acid and luteolin synergistically inhibit the proliferation of interleukin-1 beta-induced fibroblast-like synoviocytes through regulating the activation of NF-kappa B and JAK/STAT-signaling pathways

作者: Lou, LX (Lou, Lixia); Liu, YJ (Liu, Yujun); Zhou, JW (Zhou, Jingwei); Wei, Y (Wei, Yi); Deng, JG (Deng, Jiagang); Dong, B (Dong, Bin); Chai, LM (Chai, Limin)

来源出版物: IMMUNOPHARMACOLOGY AND IMMUNOTOXICOLOGY 卷: 37 期: 6 页: 499-507 DOI: 10.3109/08923973.2015.1095763 出版年: NOV 2 2015

第 4 条，共 9 条

标题: Cell cycle synchronization reveals greater G2/M-phase accumulation of lung epithelial cells exposed to titanium dioxide nanoparticles

作者: Medina-Reyes, EI (Medina-Reyes, Estefany I.); Bucio-Lopez, L (Bucio-Lopez, Laura); Freyre-Fonseca, V (Freyre-Fonseca, Veronica); Sanchez-Perez, Y (Sanchez-Perez, Yesennia); Garcia-Cuellar, CM (Garcia-Cuellar, Claudia M.); Morales-Barcenas, R

(Morales-Barcenas, Rocio); Pedraza-Chaverri, J (Pedraza-Chaverri, Jose); Chirino, YI (Chirino, Yolanda I.)
来源出版物: ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH 卷: 22 期: 5 页: 3976-3982 DOI: 10.1007/s11356-014-3871-y 出版年: MAR 2015
第 5 条，共 9 条
标题: The Study on Inhibition of Planktonic Bacterial Growth by Non-Thermal Atmospheric Pressure Plasma Jet Treated Surfaces for Dental Application
作者: Yoo, EM (Yoo, Eun-Mi); Uhm, SH (Uhm, Soo-Hyuk); Kwon, JS (Kwon, Jae-Sung); Choi, HS (Choi, Hye-Sook); Choi, EH (Choi, Eun Ha); Kim, KM (Kim, Kwang-Mahn); Kim, KN (Kim, Kyoung-Nam)
来源出版物: JOURNAL OF BIOMEDICAL NANOTECHNOLOGY 卷: 11 期: 2 页: 334-341 DOI: 10.1166/jbn.2015.2030 出版年: FEB 2015
第 6 条，共 9 条
标题: Titanium dioxide nanoparticles enhance production of superoxide anion and alter the antioxidant system in human osteoblast cells
作者: Niska, K (Niska, Karolina); Pyszka, K (Pyszka, Katarzyna); Tukaj, C (Tukaj, Cecylia); Wozniak, M (Wozniak, Michal); Radomski, MW (Radomski, Marek Witold); Inkielewicz-Stepniak, I (Inkielewicz-Stepniak, Iwona)
来源出版物: INTERNATIONAL JOURNAL OF NANOMEDICINE 卷: 10 页: 1095-1107 DOI: 10.2147/IJN.S73557 出版年: 2015
第 7 条，共 9 条
标题: Molecular Toxicity of Nanomaterials
作者: Chang, XL (Chang, Xue-Ling); Yang, ST (Yang, Sheng-Tao); Xing, GM (Xing, Gengmei)
来源出版物: JOURNAL OF BIOMEDICAL NANOTECHNOLOGY 卷: 10 期: 10 特刊: SI 页: 2828-2851 DOI: 10.1166/jbn.2014.1936 出版年: OCT 2014
第 8 条，共 9 条
标题: Biocompatibility of core@shell particles: Cytotoxicity and genotoxicity in human osteosarcoma cells of colloidal silica spheres coated with crystalline or amorphous zirconia
作者: Di Virgilio, AL (Di Virgilio, A. L.); Arnal, PM (Arnal, P. M.); Maisuls, I (Maisuls, I.)
来源出版物: MUTATION RESEARCH-GENETIC TOXICOLOGY AND ENVIRONMENTAL MUTAGENESIS 卷: 770 页: 85-94 DOI: 10.1016/j.mrgentox.2014.05.009 出版年: AUG 2014
第 9 条，共 9 条

标题: Mechanistic characterization of titanium dioxide nanoparticle-induced toxicity using electron spin resonance
作者: Li, M (Li, Meng); Yin, JJ (Yin, Jun-Jie); Wamer, WG (Wamer, Wayne G.); Lo, YM (Lo, Y. Martin)
来源出版物: JOURNAL OF FOOD AND DRUG ANALYSIS 卷: 22 期: 1 特刊: SI 页: 76-85 DOI: 10.1016/j.jfda.2014.01.006 出版年: MAR 2014

第 4 条，共 12 条
标题: Titanium Dioxide Nanoparticles Induced Proinflammation of Primary Cultured Cardiac Myocytes of Rat
作者: Song, W (Song, Wei); Wang, JX (Wang, Jiangxue); Liu, ML (Liu, Meili); Li, P (Li, Ping); Zhou, G (Zhou, Gang); Li, Z (Li, Zhou); Fan, YB (Fan, Yubo)
来源出版物: JOURNAL OF NANOMATERIALS 文献号: 349140 DOI: 10.1155/2013/349140 出版年: 2013
Web of Science 核心合集中的 "被引频次": 1
第 1 条，共 1 条
标题: Cytotoxicity Comparison of the Nanoparticles Deposited on Latex Rubber Bands between the Original and Stretched State
作者: Lee, JH (Lee, Jung-Hwan); Lee, EJ (Lee, Eun-Jung); Kwon, JS (Kwon, Jae-Sung); Hwang, CJ (Hwang, Chung-Ju); Kim, KN (Kim, Kyoung-Nam)
来源出版物: JOURNAL OF NANOMATERIALS 文献号: 567827 DOI: 10.1155/2014/567827 出版年: 2014

第 5 条，共 12 条
标题: Evaluation on Cartilage Morphology after Intra-Articular Injection of Titanium Dioxide Nanoparticles in Rats
作者: Wang, JX (Wang, Jiangxue); Gao, Y (Gao, Yu); Hou, Y (Hou, Ying); Zhao, F (Zhao, Feng); Pu, F (Pu, Fang); Liu, XY (Liu, Xiaoyu); Wu, ZH (Wu, Zhihong); Fan, YB (Fan, Yubo)
来源出版物: JOURNAL OF NANOMATERIALS 文献号: 452767 DOI: 10.1155/2012/452767 出版年: 2012
Web of Science 核心合集中的 "被引频次": 2
第 1 条，共 2 条
标题: Application and Performance of 3D Printing in Nanobiomaterials
作者: Liu, WY (Liu, Wenyong); Li, Y (Li, Ying); Liu, JY (Liu, Jinyu); Niu, XF (Niu,

Xufeng); Wang, Y (Wang, Yu); Li, DY (Li, Deyu)
来源出版物: JOURNAL OF NANOMATERIALS 文献号: 681050 DOI: 10.1155/2013/681050 出版年: 2013
第 2 条，共 2 条
标题: Biocompatibility and Toxicity of Magnetic Nanoparticles in Regenerative Medicine
作者: Markides, H (Markides, H.); Rotherham, M (Rotherham, M.); El Haj, AJ (El Haj, A. J.)
来源出版物: JOURNAL OF NANOMATERIALS 文献号: 614094 DOI: 10.1155/2012/614094 出版年: 2012

第 6 条，共 12 条
标题: Repair of Bone Defect in Femoral Condyle Using Microencapsulated Chitosan, Nanohydroxyapatite/Collagen and Poly(L-Lactide)-Based Microsphere-Scaffold Delivery System
作者: Niu, XF (Niu, Xufeng); Fan, YB (Fan, Yubo); Liu, XH (Liu, Xinhui); Li, XM (Li, Xiaoming); Li, P (Li, Ping); Wang, JX (Wang, Jiangxue); Sha, ZY (Sha, Ziyi); Feng, QL (Feng, Qingling)
来源出版物: ARTIFICIAL ORGANS 卷: 35 期: 7 页: E119-E128 DOI: 10.1111/j.1525-1594.2011.01274.x 出版年: JUL 2011
Web of Science 核心合集中的 "被引频次": 11
第 1 条，共 11 条
标题: Hollow hydroxyapatite microspheres/chitosan composite as a sustained delivery vehicle for rhBMP-2 in the treatment of bone defects
作者: Yao, AH (Yao, Ai-Hua); Li, XD (Li, Xu-Dong); Xiong, L (Xiong, Long); Zeng, JH (Zeng, Jian-Hua); Xu, J (Xu, Jun); Wang, DP (Wang, De-Ping)
来源出版物: JOURNAL OF MATERIALS SCIENCE-MATERIALS IN MEDICINE 卷: 26 期: 1 文献号: UNSP 25 DOI: 10.1007/s10856-014-5336-8 出版年: JAN 2015
第 2 条，共 11 条
标题: Nano-Hydroxyapatite Composite Biomaterials for Bone Tissue Engineering-A Review
作者: Venkatesan, J (Venkatesan, Jayachandran); Kim, SK (Kim, Se-Kwon)
来源出版物: JOURNAL OF BIOMEDICAL NANOTECHNOLOGY 卷: 10 期: 10 特刊: SI 页: 3124-3140 DOI: 10.1166/jbn.2014.1893 出版年: OCT 2014
第 3 条，共 11 条

标题: Biomaterial-based scaffolds - current status and future directions
作者: Garg, T (Garg, Tarun); Goyal, AK (Goyal, Amit K.)
来源出版物: EXPERT OPINION ON DRUG DELIVERY 卷: 11 期: 5 页: 767-789 DOI: 10.1517/17425247.2014.891014 出版年: MAY 2014
第 4 条，共 11 条
标题: Chitosan-based scaffolds for bone tissue engineering
作者: Levengood, SKL (Levengood, Sheeny K. Lan); Zhang, MQ (Zhang, Miqin)
来源出版物: JOURNAL OF MATERIALS CHEMISTRY B 卷: 2 期: 21 页: 3161-3184 DOI: 10.1039/c4tb00027g 出版年: 2014
第 5 条，共 11 条
标题: Physical properties and in vitro evaluation of collagen-chitosan-calcium phosphate microparticle-based scaffolds for bone tissue regeneration
作者: Zugravu, MV (Zugravu, Monica V.); Smith, RA (Smith, Richard A.); Reves, BT (Reves, Benjamin T.); Jennings, JA (Jennings, Jessica A.); Cooper, JO (Cooper, Jared O.); Haggard, WO (Haggard, Warren O.); Bumgardner, JD (Bumgardner, Joel D.)
来源出版物: JOURNAL OF BIOMATERIALS APPLICATIONS 卷: 28 期: 4 页: 566-579 DOI: 10.1177/0885328212465662 出版年: NOV 2013
第 6 条，共 11 条
标题: Fiber-Based Composite Tissue Engineering Scaffolds for Drug Delivery
作者: Trachtenberg, JE (Trachtenberg, Jordan E.); Mountziaris, PM (Mountziaris, Paschalia M.); Kasper, FK (Kasper, F. Kurtis); Mikos, AG (Mikos, Antonios G.)
来源出版物: ISRAEL JOURNAL OF CHEMISTRY 卷: 53 期: 9-10 特刊: SI 页: 646-654 DOI: 10.1002/ijch.201300051 出版年: OCT 2013
第 7 条，共 11 条
标题: Enhanced Healing of Rat Calvarial Critical Size Defect with Selenium-Doped Lamellar Biocomposites
作者: Wang, YH (Wang, Yanhua); Lv, P (Lv, Peng); Ma, Z (Ma, Zhe); Zhang, JC (Zhang, Jingcheng)
来源出版物: BIOLOGICAL TRACE ELEMENT RESEARCH 卷: 155 期: 1 页: 72-81 DOI: 10.1007/s12011-013-9763-z 出版年: OCT 2013
第 8 条，共 11 条
标题: Naturally and synthetic smart composite biomaterials for tissue regeneration
作者: Perez, RA (Perez, Roman A.); Won, JE (Won, Jong-Eun); Knowles, JC (Knowles, Jonathan C.); Kim, HW (Kim, Hae-Won)

来源出版物: ADVANCED DRUG DELIVERY REVIEWS 卷: 65 期: 4 页: 471-496 DOI: 10.1016/j.addr.2012.03.009 出版年: APR 2013

第 9 条，共 11 条

标题: Biomimetic hydroxyapatite coating on pore walls improves osteointegration of poly(L-lactic acid) scaffolds

作者: Deplaine, H (Deplaine, H.); Lebourg, M (Lebourg, M.); Ripalda, P (Ripalda, P.); Vidaurre, A (Vidaurre, A.); Sanz-Ramos, P (Sanz-Ramos, P.); Mora, G (Mora, G.); Prosper, F (Prosper, F.); Ochoa, I (Ochoa, I.); Doblare, M (Doblare, M.); Ribelles, JLG (Gomez Ribelles, J. L.); Izal-Azcarate, I (Izal-Azcarate, I.); Ferrer, GG (Gallego Ferrer, G.)

来源出版物: JOURNAL OF BIOMEDICAL MATERIALS RESEARCH PART B-APPLIED BIOMATERIALS 卷: 101B 期: 1 页: 173-186 DOI: 10.1002/jbm.b.32831 出版年: JAN 2013

第 10 条，共 11 条

标题: Synthesis and application of nanostructured calcium phosphate ceramics for bone regeneration

作者: Cardoso, DA (Cardoso, D. Alves); Jansen, JA (Jansen, J. A.); Leeuwenburgh, SCG (Leeuwenburgh, S. C. G.)

来源出版物: JOURNAL OF BIOMEDICAL MATERIALS RESEARCH PART B-APPLIED BIOMATERIALS 卷: 100B 期: 8 页: 2316-2326 DOI: 10.1002/jbm.b.32794 出版年: NOV 2012

第 11 条，共 11 条

标题: Artificial Organs 2011: A Year in Review

作者: Malchesky, PS (Malchesky, Paul S.)

来源出版物: ARTIFICIAL ORGANS 卷: 36 期: 3 页: 291-323 DOI: 10.1111/j.1525-1594.2012.01438.x 出版年: MAR 2012

第 7 条，共 12 条

标题: Potential Health Impact on Mice after Nasal Instillation of Nano-Sized Copper Particles and Their Translocation in Mice

作者: Liu, Y (Liu, Yang); Gao, YX (Gao, Yuxi); Zhang, LL (Zhang, Lili); Wang, TC (Wang, Tiancheng); Wang, JX (Wang, Jiangxue); Jiao, F (Jiao, Fang); Li, W (Li, Wei); Liu, Y (Liu, Ying); Li, YF (Li, Yufeng); Li, B (Li, Bai); Chai, ZF (Chai, Zhifang); Wu, G (Wu, Gang); Chen, CY (Chen, Chunying)

来源出版物: JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 卷: 9 期: 11 页: 6335-6343 DOI: 10.1166/jnn.2009.1320 出版年: NOV 2009

Web of Science 核心合集中的 "被引频次": 26

第 1 条，共 26 条

标题: Graphene oxide modulates root growth of Brassica napus L. and regulates ABA and IAA concentration

作者: Cheng, F (Cheng, Fan); Liu, YF (Liu, Yu-Feng); Lu, GY (Lu, Guang-Yuan); Zhang, XK (Zhang, Xue-Kun); Xie, LL (Xie, Ling-Li); Yuan, CF (Yuan, Cheng-Fei); Xu, BB (Xu, Ben-Bo)

来源出版物: JOURNAL OF PLANT PHYSIOLOGY 卷: 193 页: 57-63 DOI: 10.1016/j.jplph.2016.02.011 出版年: APR 1 2016

第 2 条，共 26 条

标题: Effects of copper oxide nanoparticles on developing zebrafish embryos and larvae

作者: Sun, Y (Sun, Yan); Zhang, G (Zhang, Gong); He, ZZ (He, Zizi); Wang, YJ (Wang, Yajie); Cui, JL (Cui, Jianlin); Li, YH (Li, Yuhao)

来源出版物: INTERNATIONAL JOURNAL OF NANOMEDICINE 卷: 11 页: 905-918 DOI: 10.2147/IJN.S100350 出版年: 2016

第 3 条，共 26 条

标题: Effects of the size and morphology of zinc oxide nanoparticles on the germination of Chinese cabbage seeds

作者: Xiang, L (Xiang, Lei); Zhao, HM (Zhao, Hai-Ming); Li, YW (Li, Yan-Wen); Huang, XP (Huang, Xian-Pei); Wu, XL (Wu, Xiao-Lian); Zhai, T (Zhai, Teng); Yuan, Y (Yuan, Yue); Cai, QY (Cai, Quan-Ying); Mo, CH (Mo, Ce-Hui)

来源出版物: ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH 卷: 22 期: 14 页: 10452-10462 DOI: 10.1007/s11356-015-4172-9 出版年: JUL 2015

第 4 条，共 26 条

标题: Toxicology of Drug Nanocarriers

作者: Vaculikova, E (Vaculikova, E.); Placha, D (Placha, D.); Jampilek, J (Jampilek, J.)

来源出版物: CHEMICKE LISTY 卷: 109 期: 5 页: 346-352 出版年: MAY 2015

第 5 条，共 26 条

标题: Characterization and phytotoxicity studies of suspended particulate matter (SPM) in Chennai urban area

作者: Durga, M (Durga, M.); Bharathi, S (Bharathi, S.); Murthy, PB (Murthy, P. Balakrishna); Devasena, T (Devasena, T.)

来源出版物: JOURNAL OF ENVIRONMENTAL BIOLOGY 卷: 36 期: 3 页: 583-589 出版年: MAY 2015

第 6 条，共 26 条

标题: Effects of Graphene on Germination and Seedling Morphology in Rice

作者: Liu, SJ (Liu, Shangjie); Wei, HM (Wei, Hongmin); Li, ZY (Li, Zhiyang); Li, S (Li, Shun); Yan, H (Yan, Han); He, Y (He, Yong); Tian, ZH (Tian, Zhihong)

来源出版物: JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 卷: 15 期: 4 页: 2695-2701 DOI: 10.1166/jnn.2015.9254 出版年: APR 2015

第 7 条，共 26 条

标题: Renal Clearance and Degradation of Glutathione-Coated Copper Nanoparticles

作者: Yang, SY (Yang, Shengyang); Sun, SS (Sun, Shasha); Zhou, C (Zhou, Chen); Hao, GY (Hao, Guiyang); Liu, JB (Liu, Jinbin); Ramezani, S (Ramezani, Saleh); Yu, MX (Yu, Mengxiao); Sun, XK (Sun, Xiankai); Zheng, J (Zheng, Jie)

来源出版物: BIOCONJUGATE CHEMISTRY 卷: 26 期: 3 页: 511-519 DOI: 10.1021/acs.bioconjchem.5b00003 出版年: MAR 2015

第 8 条，共 26 条

标题: Copper Oxide Nanoparticles Stimulate Glycolytic Flux and Increase the Cellular Contents of Glutathione and Metallothioneins in Cultured Astrocytes

作者: Bulcke, F (Bulcke, Felix); Dringen, R (Dringen, Ralf)

来源出版物: NEUROCHEMICAL RESEARCH 卷: 40 期: 1 页: 15-26 DOI: 10.1007/s11064-014-1458-0 出版年: JAN 2015

第 9 条，共 26 条

标题: Effects of ultrafine petrol exhaust particles on cytotoxicity, oxidative stress generation, DNA damage and inflammation in human A549 lung cells and murine RAW 264.7 macrophages

作者: Durga, M (Durga, Mohan); Nathiya, S (Nathiya, Soundararajan); Rajasekar, A (Rajasekar, Abbu); Devasena, T (Devasena, Thiyagarajan)

来源出版物: ENVIRONMENTAL TOXICOLOGY AND PHARMACOLOGY 卷: 38 期: 2 页: 518-530 DOI: 10.1016/j.etap.2014.08.003 出版年: SEP 2014

第 10 条，共 26 条

标题: Oxidation of siloxanes during biogas combustion and nanotoxicity of Si-based particles released to the atmosphere

作者: Tansel, B (Tansel, Berrin); Surita, SC (Surita, Sharon C.)

来源出版物: ENVIRONMENTAL TOXICOLOGY AND PHARMACOLOGY 卷: 37 期: 1 页: 166-173 DOI: 10.1016/j.etap.2013.11.020 出版年: JAN 2014

第 11 条，共 26 条

标题: Renal clearable inorganic nanoparticles: a new frontier of bionanotechnology
作者: Liu, JB (Liu, Jinbin); Yu, MX (Yu, Mengxiao); Zhou, C (Zhou, Chen); Zheng, J (Zheng, Jie)
来源出版物: MATERIALS TODAY 卷: 16 期: 12 页: 477-486 DOI: 10.1016/j.mattod.2013.11.003 出版年: DEC 2013
第 12 条，共 26 条
标题: Intranasal exposure to amorphous nanosilica particles could activate intrinsic coagulation cascade and platelets in mice
作者: Yoshida, T (Yoshida, Tokuyuki); Yoshioka, Y (Yoshioka, Yasuo); Tochigi, S (Tochigi, Saeko); Hirai, T (Hirai, Toshiro); Uji, M (Uji, Miyuki); Ichihashi, K (Ichihashi, Ko-ichi); Nagano, K (Nagano, Kazuya); Abe, Y (Abe, Yasuhiro); Kamada, H (Kamada, Haruhiko); Tsunoda, S (Tsunoda, Shin-ichi); Nabeshi, H (Nabeshi, Hiromi); Higashisaka, K (Higashisaka, Kazuma); Yoshikawa, T (Yoshikawa, Tomoaki); Tsutsumi, Y (Tsutsumi, Yasuo)
来源出版物: PARTICLE AND FIBRE TOXICOLOGY 卷: 10 文献号: UNSP 41 DOI: 10.1186/1743-8977-10-41 出版年: AUG 20 2013
第 13 条，共 26 条
标题: Monitoring trace elements generated by automobiles: air pollutants with possible health impacts
作者: Anwar, K (Anwar, Khaleeq); Ejaz, S (Ejaz, Sohail); Ashraf, M (Ashraf, Muhammad); Ahmad, N (Ahmad, Nisar); Javeed, A (Javeed, Aqeel)
来源出版物: ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH 卷: 20 期: 7 页: 4574-4586 DOI: 10.1007/s11356-012-1383-1 出版年: JUL 2013
第 14 条，共 26 条
标题: Advances in integrative nanomedicine for improving infectious disease treatment in public health
作者: Bell, IR (Bell, Iris R.); Schwartz, GE (Schwartz, Gary E.); Boyer, NN (Boyer, Nancy N.); Koithan, M (Koithan, Mary); Brooks, AJ (Brooks, Audrey J.)
来源出版物: EUROPEAN JOURNAL OF INTEGRATIVE MEDICINE 卷: 5 期: 2 页: 126-140 DOI: 10.1016/j.eujim.2012.11.002 出版年: APR 2013
第 15 条，共 26 条
标题: Genotoxicity and carcinogenicity of cobalt-, nickel- and copper-based nanoparticles (Review)
作者: Magaye, R (Magaye, Ruth); Zhao, JS (Zhao, Jinshun); Bowman, L (Bowman, Linda); Ding, M (Ding, Min)

来源出版物: EXPERIMENTAL AND THERAPEUTIC MEDICINE 卷: 4 期: 4 页: 551-561 DOI: 10.3892/etm.2012.656 出版年: OCT 2012

第 16 条，共 26 条

标题: The neurotoxic potential of engineered nanomaterials

作者: Boyes, WK (Boyes, William K.); Chen, R (Chen, Rui); Chen, CY (Chen, Chunying); Yokel, RA (Yokel, Robert A.)

来源出版物: NEUROTOXICOLOGY 卷: 33 期: 4 特刊: SI 页: 902-910 DOI: 10.1016/j.neuro.2011.12.013 出版年: AUG 2012

第 17 条，共 26 条

标题: Effects of copper nanoparticles on rat cerebral microvessel endothelial cells

作者: Trickler, WJ (Trickler, William J.); Lantz, SM (Lantz, Susan M.); Schrand, AM (Schrand, Amanda M.); Robinson, BL (Robinson, Bonnie L.); Newport, GD (Newport, Glenn D.); Schlager, JJ (Schlager, John J.); Paule, MG (Paule, Merle G.); Slikker, W (Slikker, William); Biris, AS (Biris, Alexandru S.); Hussain, SM (Hussain, Saber M.); Ali, SF (Ali, Syed F.)

来源出版物: NANOMEDICINE 卷: 7 期: 6 页: 835-846 DOI: 10.2217/NNM.11.154 出版年: JUN 2012

第 18 条，共 26 条

标题: Manufactured and airborne nanoparticle cardiopulmonary interactions: a review of mechanisms and the possible contribution of mast cells

作者: Shannahan, JH (Shannahan, Jonathan H.); Kodavanti, UP (Kodavanti, Urmila P.); Brown, JM (Brown, Jared M.)

来源出版物: INHALATION TOXICOLOGY 卷: 24 期: 5 页: 320-339 DOI: 10.3109/08958378.2012.668229 出版年: APR 2012

第 19 条，共 26 条

标题: Toxicology of nanoparticles

作者: Elsaesser, A (Elsaesser, Andreas); Howard, CV (Howard, C. Vyvyan)

来源出版物: ADVANCED DRUG DELIVERY REVIEWS 卷: 64 期: 2 页: 129-137 DOI: 10.1016/j.addr.2011.09.001 出版年: FEB 2012

第 20 条，共 26 条

标题: Nasal instillation of nanoparticle-rich diesel exhaust particles slightly affects emotional behavior and learning capability in rats

作者: Yokota, S (Yokota, Syunji); Takashima, H (Takashima, Hiromasa); Ohta, R (Ohta, Ryo); Saito, Y (Saito, Yoshiaki); Miyahara, T (Miyahara, Takashi); Yoshida, Y (Yoshida,

Yuka); Negura, T (Negura, Tsukasa); Senuma, M (Senuma, Mika); Usumi, K (Usumi, Kenji); Hirabayashi, N (Hirabayashi, Naoyuki); Watanabe, T (Watanabe, Takaho); Horiuchi, S (Horiuchi, Shinji); Fujitani, Y (Fujitani, Yuji); Hirano, S (Hirano, Seishiro); Fujimaki, H (Fujimaki, Hidekazu)

来源出版物: JOURNAL OF TOXICOLOGICAL SCIENCES 卷: 36 期: 3 页: 267-276 出版年: JUN 2011

第 21 条，共 26 条

标题: Repeated-dose toxicity attributed to aluminum nanoparticles following 28-day oral administration, particularly on gene expression in mouse brain

作者: Park, EJ (Park, Eun-Jung); Kim, H (Kim, Hero); Kim, Y (Kim, Younghun); Choi, K (Choi, Kyunghee)

来源出版物: TOXICOLOGICAL AND ENVIRONMENTAL CHEMISTRY 卷: 93 期: 1 页: 120-133 DOI: 10.1080/02772248.2010.495191 出版年: 2011

第 22 条，共 26 条

标题: Intratracheal instillation of cerium oxide nanoparticles induces hepatic toxicity in male Sprague-Dawley rats

作者: Nalabotu, SK (Nalabotu, Siva K.); Kolli, MB (Kolli, Madhukar B.); Triest, WE (Triest, William E.); Ma, JY (Ma, Jane Y.); Manne, NDPK (Manne, Nandini D. P. K.); Katta, A (Katta, Anjaiah); Addagarla, HS (Addagarla, Hari S.); Rice, KM (Rice, Kevin M.); Blough, ER (Blough, Eric R.)

来源出版物: INTERNATIONAL JOURNAL OF NANOMEDICINE 卷: 6 页: 2327-2335 DOI: 10.2147/IJN.S25119 出版年: 2011

第 23 条，共 26 条

标题: Atomic spectrometry update. Clinical and biological materials, foods and beverages

作者: Taylor, A (Taylor, Andrew); Branch, S (Branch, Simon); Day, MP (Day, Martin P.); Patriarca, M (Patriarca, Marina); White, M (White, Mark)

来源出版物: JOURNAL OF ANALYTICAL ATOMIC SPECTROMETRY 卷: 26 期: 4 页: 653-692 DOI: 10.1039/c1ja90006d 出版年: 2011

第 24 条，共 26 条

标题: TOXICOLOGY OF NANOMATERIALS USED IN NANOMEDICINE

作者: Zhao, JS (Zhao, Jinshun); Castranova, V (Castranova, Vincent)

来源出版物: JOURNAL OF TOXICOLOGY AND ENVIRONMENTAL HEALTH-PART B-CRITICAL REVIEWS 卷: 14 期: 8 页: 593-632 DOI: 10.1080/10937404.2011.615113 出版年: 2011

第 25 条，共 26 条

标题: Risks from accidental exposures to engineered nanoparticles and neurological health effects: A critical review
作者: Simko, M (Simko, Myrtill); Mattsson, MO (Mattsson, Mats-Olof)
来源出版物: PARTICLE AND FIBRE TOXICOLOGY 卷: 7 文献号: 42 DOI: 10.1186/1743-8977-7-42 出版年: DEC 21 2010
第 26 条，共 26 条
标题: Functionalization impacts the effects of carbon nanotubes on the immune system of rainbow trout, Oncorhynchus mykiss
作者: Klaper, R (Klaper, Rebecca); Arndt, D (Arndt, Devrah); Setyowati, K (Setyowati, Kristin); Chen, JA (Chen, Jian); Goetz, F (Goetz, Frederick)
来源出版物: AQUATIC TOXICOLOGY 卷: 100 期: 2 页: 211-217 DOI: 10.1016/j.aquatox.2010.07.023 出版年: OCT 15 2010

第 8 条，共 12 条
标题: TiO2 nanoparticles translocation and potential toxicological effect in rats after intraarticular injection
作者: Wang, JX (Wang, Jiang-Xue); Fan, YB (Fan, Yu-Bo); Gao, Y (Gao, Yu); Hu, QH (Hu, Qing-Hua); Wang, TC (Wang, Tian-Cheng)
来源出版物: BIOMATERIALS 卷: 30 期: 27 页: 4590-4600 DOI: 10.1016/j.biomaterials.2009.05.008 出版年: SEP 2009
Web of Science 核心合集中的 "被引频次": 44
第 1 条，共 44 条
标题: Disturbance of ion environment and immune regulation following biodistribution of magnetic iron oxide nanoparticles injected intravenously
作者: Park, EJ (Park, Eun-Jung); Kim, SW (Kim, Sang-Wook); Yoon, C (Yoon, Cheolho); Kim, Y (Kim, Younghun); Kim, JS (Kim, Jong Sung)
来源出版物: TOXICOLOGY LETTERS 卷: 243 页: 67-77 DOI: 10.1016/j.toxlet.2015.11.030 出版年: JAN 22 2016
第 2 条，共 44 条
标题: The biological effects upon the cardiovascular system consequent to exposure to particulates of less than 500 nm in size
作者: Clark, J (Clark, James); Gregory, CC (Gregory, Clive C.); Matthews, IP (Matthews, Ian P.); Hoogendoorn, B (Hoogendoorn, Bastiaan)
来源出版物: BIOMARKERS 卷: 21 期: 1 页: 1-47 DOI:

10.3109/1354750X.2015.1118540 出版年: JAN 2 2016

第 3 条，共 44 条

标题: Toxicology of nanosized titanium dioxide: an update

作者: Zhang, XC (Zhang, Xiaochen); Li, W (Li, Wen); Yang, Z (Yang, Zhuo)

来源出版物: ARCHIVES OF TOXICOLOGY 卷: 89 期: 12 页: 2207-2217 DOI: 10.1007/s00204-015-1594-6 出版年: DEC 2015

第 4 条，共 44 条

标题: Flow Cytometry Analysis of Cytotoxicity In Vitro and Long-Term Toxicity of HA-40wt% BaTiO3 Nanoparticles In Vivo

作者: Kumar, A (Kumar, Alok); Bhaskar, N (Bhaskar, Nitu); Basu, B (Basu, Bikramjit)

来源出版物: JOURNAL OF THE AMERICAN CERAMIC SOCIETY 卷: 98 期: 10 页: 3202-3211 DOI: 10.1111/jace.13740 出版年: OCT 2015

第 5 条，共 44 条

标题: 45S5 Bioglass (R)-MWCNT composite: processing and bioactivity

作者: Porwal, H (Porwal, Harshit); Estili, M (Estili, Mehdi); Grunewald, A (Gruenewald, Alina); Grasso, S (Grasso, Salvatore); Detsch, R (Detsch, Rainer); Hu, CF (Hu, Chunfeng); Sakka, Y (Sakka, Yoshio); Boccaccini, AR (Boccaccini, Aldo R.); Reece, MJ (Reece, Mike J.)

来源出版物: JOURNAL OF MATERIALS SCIENCE-MATERIALS IN MEDICINE 卷: 26 期: 6 文献号: 199 DOI: 10.1007/s10856-015-5529-9 出版年: JUN 2015

第 6 条，共 44 条

标题: Subacute toxicity of titanium dioxide (TiO2) nanoparticles in male rats: emotional behavior and pathophysiological examination

作者: Ben Younes, NR (Ben Younes, Naima Rihane); Amara, S (Amara, Salem); Mrad, I (Mrad, Imen); Ben-Slama, I (Ben-Slama, Imen); Jeljeli, M (Jeljeli, Mustapha); Omri, K (Omri, Karim); El Ghoul, J (El Ghoul, Jaber); El Mir, L (El Mir, Lassaad); Ben Rhouma, K (Ben Rhouma, Khemais); Abdelmelek, H (Abdelmelek, Hafedh); Sakly, M (Sakly, Mohsen)

来源出版物: ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH 卷: 22 期: 11 页: 8728-8737 DOI: 10.1007/s11356-014-4002-5 出版年: JUN 2015

第 7 条，共 44 条

标题: Beneficial effects of quercetin on oxidative stress in liver and kidney induced by titanium dioxide (TiO2) nanoparticles in rats

作者: Gonzalez-Esquivel, AE (Emmanuel Gonzalez-Esquivel, Aaron); Charles-Nino, CL (Lisset Charles-Nino, Claudia); Pacheco-Moises, FP (Paul Pacheco-Moises, Fermin); Ortiz, GG (Gabriel Ortiz, Genaro); Jaramillo-Juarez, F (Jaramillo-Juarez, Fernando);

Rincon-Sanchez, AR (Rosa Rincon-Sanchez, Ana)
来源出版物: TOXICOLOGY MECHANISMS AND METHODS 卷: 25 期: 3 页: 166-175 DOI: 10.3109/15376516.2015.1006491 出版年: MAR 2015
第 8 条，共 44 条
标题: Absence of systemic toxicity in mouse model towards BaTiO3 nanoparticulate based eluate treatment
作者: Dubey, AK (Dubey, Ashutosh Kumar); Thrivikraman, G (Thrivikraman, Greeshma); Basu, B (Basu, Bikramjit)
来源出版物: JOURNAL OF MATERIALS SCIENCE-MATERIALS IN MEDICINE 卷: 26 期: 2 文献号: 103 DOI: 10.1007/s10856-015-5414-6 出版年: FEB 2015
第 9 条，共 44 条
标题: In vivo biodistribution and toxicity of Gd2O3:Eu3+ nanotubes in mice after intraperitoneal injection
作者: Liu, HF (Liu, Huifang); Jia, G (Jia, Guang); Chen, SZ (Chen, Shizhu); Ma, HY (Ma, Huanyun); Zhao, YY (Zhao, Yanyan); Wang, JG (Wang, Jianguo); Zhang, CM (Zhang, Cuimiao); Wang, SX (Wang, Shuxian); Zhang, JC (Zhang, Jinchao)
来源出版物: RSC ADVANCES 卷: 5 期: 90 页: 73601-73611 DOI: 10.1039/c5ra13861b 出版年: 2015
第 10 条，共 44 条
标题: Titanium dioxide nanoparticles enhance production of superoxide anion and alter the antioxidant system in human osteoblast cells
作者: Niska, K (Niska, Karolina); Pyszka, K (Pyszka, Katarzyna); Tukaj, C (Tukaj, Cecylia); Wozniak, M (Wozniak, Michal); Radomski, MW (Radomski, Marek Witold); Inkielewicz-Stepniak, I (Inkielewicz-Stepniak, Iwona)
来源出版物: INTERNATIONAL JOURNAL OF NANOMEDICINE 卷: 10 页: 1095-1107 DOI: 10.2147/IJN.S73557 出版年: 2015
第 11 条，共 44 条
标题: Effects of mesoporous SiO2, Fe3O4, and TiO2 nanoparticles on the biological functions of endothelial cells in vitro
作者: Hou, YH (Hou, Yanhua); Lai, M (Lai, Min); Chen, XY (Chen, Xiuyong); Li, JH (Li, Jinghua); Hu, Y (Hu, Yan); Luo, Z (Luo, Zhong); Ding, XW (Ding, Xingwei); Cai, KY (Cai, Kaiyong)
来源出版物: JOURNAL OF BIOMEDICAL MATERIALS RESEARCH PART A 卷: 102 期: 6 页: 1726-1736 DOI: 10.1002/jbm.a.34839 出版年: JUN 2014
第 12 条，共 44 条

标题: Oxidative stress increased hepatotoxicity induced by nano-titanium dioxide in BRL-3A cells and Sprague-Dawley rats
作者: Sha, BY (Sha, Baoyong); Gao, W (Gao, Wei); Wang, SQ (Wang, Shuqi); Gou, XC (Gou, Xingchun); Li, W (Li, Wei); Liang, X (Liang, Xuan); Qu, ZG (Qu, Zhiguo); Xu, F (Xu, Feng); Lu, TJ (Lu, Tian Jian)
来源出版物: JOURNAL OF APPLIED TOXICOLOGY 卷: 34 期: 4 页: 345-356 DOI: 10.1002/jat.2900 出版年: APR 2014
第 13 条，共 44 条
标题: Formulation and Optimization of Nonionic Surfactants Emulsified Nimesulide-Loaded PLGA-Based Nanoparticles by Design of Experiments
作者: Turk, CTS (Turk, Ceyda Tuba Sengel); Oz, UC (Oz, Umut Can); Serim, TM (Serim, Tugrul Mert); Hascicek, C (Hascicek, Canan)
来源出版物: AAPS PHARMSCITECH 卷: 15 期: 1 页: 161-176 DOI: 10.1208/s12249-013-0048-9 出版年: FEB 2014
第 14 条，共 44 条
标题: The in vivo underlying mechanism for recovery response formation in nano-titanium dioxide exposed Caenorhabditis elegans after transfer to the normal condition
作者: Zhao, YL (Zhao, Yunli); Wu, QL (Wu, Qiuli); Tang, M (Tang, Meng); Wang, DY (Wang, Dayong)
来源出版物: NANOMEDICINE-NANOTECHNOLOGY BIOLOGY AND MEDICINE 卷: 10 期: 1 页: 89-98 DOI: 10.1016/j.nano.2013.07.004 出版年: JAN 2014
第 15 条，共 44 条
标题: Protective effect of Sam-Hwang-Sa-Sim-Tang against hepatic steatosis in mice fed a high-cholesterol diet
作者: Ahn, TG (Ahn, Tae-Gue); Lee, JY (Lee, Joo-Young); Cheon, SY (Cheon, Se-Yun); An, HJ (An, Hyo-Jin); Kook, YB (Kook, Yoon-Bum)
来源出版物: BMC COMPLEMENTARY AND ALTERNATIVE MEDICINE 卷: 13 文献号: 366 DOI: 10.1186/1472-6882-13-366 出版年: DEC 23 2013
第 16 条，共 44 条
标题: Reproductive toxicity in adult male rats following intra-articular injection of cobalt-chromium nanoparticles
作者: Wang, Z (Wang, Zhen); Chen, ZF (Chen, Zhefeng); Zuo, Q (Zuo, Qiang); Song, FL (Song, Fanglong); Wu, DY (Wu, Dongying); Cheng, WD (Cheng, Wendan); Fan, WM (Fan, Weimin)
来源出版物: JOURNAL OF ORTHOPAEDIC SCIENCE 卷: 18 期: 6 页: 1020-1026

DOI: 10.1007/s00776-013-0458-2 出版年: NOV 2013

第 17 条，共 44 条

标题: Nano-titanium dioxide induced cardiac injury in rat under oxidative stress

作者: Sha, BY (Sha, BaoYong); Gao, W (Gao, Wei); Wang, SQ (Wang, ShuQi); Li, W (Li, Wei); Liang, X (Liang, Xuan); Xu, F (Xu, Feng); Lu, TJ (Lu, Tian Jian)

来源出版物: FOOD AND CHEMICAL TOXICOLOGY 卷: 58 页: 280-288 DOI: 10.1016/j.fct.2013.04.050 出版年: AUG 2013

第 18 条，共 44 条

标题: Comparison of toxicity between the different-type TiO2 nanowires in vivo and in vitro

作者: Park, EJ (Park, Eun-Jung); Shim, HW (Shim, Hyun-Woo); Lee, GH (Lee, Gwang-Hee); Kim, JH (Kim, Jae-Ho); Kim, DW (Kim, Dong-Wan)

来源出版物: ARCHIVES OF TOXICOLOGY 卷: 87 期: 7 页: 1219-1230 DOI: 10.1007/s00204-013-1019-3 出版年: JUL 2013

第 19 条，共 44 条

标题: Serum Titanium, Niobium, and Aluminum Levels After Instrumented Spinal Arthrodesis in Children

作者: Cundy, TP (Cundy, Thomas P.); Antoniou, G (Antoniou, Georgia); Sutherland, LM (Sutherland, Leanne M.); Freeman, BJC (Freeman, Brian J. C.); Cundy, PJ (Cundy, Peter J.)

来源出版物: SPINE 卷: 38 期: 7 页: 564-570 DOI: 10.1097/BRS.0b013e3182741961 出版年: APR 1 2013

第 20 条，共 44 条

标题: The absorption, distribution, excretion and toxicity of mesoporous silica nanoparticles in mice following different exposure routes

作者: Fu, CH (Fu, Changhui); Liu, TL (Liu, Tianlong); Li, LL (Li, Linlin); Liu, HY (Liu, Huiyu); Chen, D (Chen, Dong); Tang, FQ (Tang, Fangqiong)

来源出版物: BIOMATERIALS 卷: 34 期: 10 页: 2565-2575 DOI: 10.1016/j.biomaterials.2012.12.043 出版年: MAR 2013

第 21 条，共 44 条

标题: Studies on liver damage induced by nanosized-titanium dioxide in mouse

作者: Jeon, YM (Jeon, Yu-Mi); Kim, WJ (Kim, Wan-Jong); Lee, MY (Lee, Mi-Young)

来源出版物: JOURNAL OF ENVIRONMENTAL BIOLOGY 卷: 34 期: 2 页: 283-287 出版年: MAR 2013

第 22 条，共 44 条

标题: Nano-titanium dioxide induces genotoxicity and apoptosis in human lung cancer cell line, A549

作者: Srivastava, RK (Srivastava, R. K.); Rahman, Q (Rahman, Q.); Kashyap, MP (Kashyap, M. P.); Singh, AK (Singh, A. K.); Jain, G (Jain, G.); Jahan, S (Jahan, S.); Lohani, M (Lohani, M.); Lantow, M (Lantow, M.); Pant, AB (Pant, A. B.)

来源出版物: HUMAN & EXPERIMENTAL TOXICOLOGY 卷: 32 期: 2 页: 153-166 DOI: 10.1177/0960327112462725 出版年: FEB 2013

第 23 条，共 44 条

标题: SYNTHESIS AND PHOTOCATALYTIC PROPERTIES OF Fe(III) - DOPED TiO2 PREPARED BY SOL-GEL METHOD

作者: Oprea, O (Oprea, Ovidiu); Ghitulica, CD (Ghitulica, Cristina Daniela); Voicu, G (Voicu, Georgeta); Vasile, BS (Vasile, Bogdan Stefan); Oprea, A (Oprea, Angelica)

来源出版物: REVISTA ROMANA DE MATERIALE-ROMANIAN JOURNAL OF MATERIALS 卷: 43 期: 4 页: 408-416 出版年: 2013

第 24 条，共 44 条

标题: The oxidative toxicity of Ag and ZnO nanoparticles towards the aquatic plant Spirodela punctuta and the role of testing media parameters

作者: Thwala, M (Thwala, Melusi); Musee, N (Musee, Ndeke); Sikhwivhilu, L (Sikhwivhilu, Lucky); Wepener, V (Wepener, Victor)

来源出版物: ENVIRONMENTAL SCIENCE-PROCESSES & IMPACTS 卷: 15 期: 10 页: 1830-1843 DOI: 10.1039/c3em00235g 出版年: 2013

第 25 条，共 44 条

标题: Effects of titanium nanoparticles on adhesion, migration, proliferation, and differentiation of mesenchymal stem cells

作者: Hou, YH (Hou, Yanhua); Cai, KY (Cai, Kaiyong); Li, JH (Li, Jinghua); Chen, XY (Chen, Xiuyong); Lai, M (Lai, Min); Hu, Y (Hu, Yan); Luo, Z (Luo, Zhong); Ding, XW (Ding, Xingwei); Xu, DW (Xu, Dawei)

来源出版物: INTERNATIONAL JOURNAL OF NANOMEDICINE 卷: 8 页: 3619-3630 DOI: 10.2147/IJN.S38992 出版年: 2013

第 26 条，共 44 条

标题: Application and Performance of 3D Printing in Nanobiomaterials

作者: Liu, WY (Liu, Wenyong); Li, Y (Li, Ying); Liu, JY (Liu, Jinyu); Niu, XF (Niu, Xufeng); Wang, Y (Wang, Yu); Li, DY (Li, Deyu)

来源出版物: JOURNAL OF NANOMATERIALS 文献号: 681050 DOI: 10.1155/2013/681050 出版年: 2013

第 27 条，共 44 条

标题: Intra-articular drug delivery for arthritis diseases: the value of extended release and targeting strategies

作者: Pradal, J (Pradal, J.); Jordan, O (Jordan, O.); Allemann, E (Allemann, E.)

来源出版物: JOURNAL OF DRUG DELIVERY SCIENCE AND TECHNOLOGY 卷: 22 期: 5 页: 409-419 出版年: SEP-OCT 2012

第 28 条，共 44 条

标题: PEGylation of Nanosubstrates (Titania) with Multifunctional Reagents: At the Crossroads between Nanoparticles and Nanocomposites

作者: Kotsokechagia, T (Kotsokechagia, Tania); Zaki, NM (Zaki, Noha M.); Syres, K (Syres, Karen); de Leonardis, P (de Leonardis, Piero); Thomas, A (Thomas, Andrew); Cellesi, F (Cellesi, Francesco); Tirelli, N (Tirelli, Nicola)

来源出版物: LANGMUIR 卷: 28 期: 31 页: 11490-11501 DOI: 10.1021/la3012958 出版年: AUG 7 2012

第 29 条，共 44 条

标题: Biological reactivity of TiO2 nanoparticles assessed by ex vivo testing

作者: Valant, J (Valant, Janez); Drobne, D (Drobne, Damjana)

来源出版物: PROTOPLASMA 卷: 249 期: 3 页: 835-842 DOI: 10.1007/s00709-011-0298-x 出版年: JUL 2012

第 30 条，共 44 条

标题: Genotoxicity of TiO2 anatase nanoparticles in B6C3F1 male mice evaluated using Pig-a and flow cytometric micronucleus assays

作者: Sadiq, R (Sadiq, Rakhshinda); Bhalli, JA (Bhalli, Javed A.); Yan, J (Yan, Jian); Woodruff, RS (Woodruff, Robert S.); Pearce, MG (Pearce, Mason G.); Li, Y (Li, Yan); Mustafa, T (Mustafa, Thikra); Watanabe, F (Watanabe, Fumiya); Pack, LM (Pack, Lindsay M.); Biris, AS (Biris, Alexandru S.); Khan, QM (Khan, Qaiser M.); Chen, T (Chen, Tao)

来源出版物: MUTATION RESEARCH-GENETIC TOXICOLOGY AND ENVIRONMENTAL MUTAGENESIS 卷: 745 期: 1-2 特刊: SI 页: 65-72 DOI: 10.1016/j.mrgentox.2012.02.002 出版年: JUN 14 2012

第 31 条，共 44 条

标题: Local and systemic toxicity of nanoscale debris particles in total hip arthroplasty

作者: Polyzois, I (Polyzois, Ioannis); Nikolopoulos, D (Nikolopoulos, Dimitrios); Michos, I (Michos, Ioannis); Patsouris, E (Patsouris, Efstratios); Theocharis, S (Theocharis, Stamatios)

来源出版物: JOURNAL OF APPLIED TOXICOLOGY 卷: 32 期: 4 页: 255-269 DOI: 10.1002/jat.2729 出版年: APR 2012

第 32 条，共 44 条

标题: Toxicological Effects of Titanium Dioxide Nanoparticles: A Review of In Vivo Studies

作者: Iavicoli, I (Iavicoli, Ivo); Leso, V (Leso, Veruscka); Bergamaschi, A (Bergamaschi, Antonio)

来源出版物: JOURNAL OF NANOMATERIALS 文献号: 964381 DOI: 10.1155/2012/964381 出版年: 2012

第 33 条，共 44 条

标题: Oxidative stress mediated cytotoxicity of TiO2 nano anatase in liver and kidney of Wistar rat

作者: Meena, R (Meena, R.); Paulraj, R (Paulraj, R.)

来源出版物: TOXICOLOGICAL AND ENVIRONMENTAL CHEMISTRY 卷: 94 期: 1 页: 146-163 DOI: 10.1080/02772248.2011.638441 出版年: 2012

第 34 条，共 44 条

标题: Tissular localization and excretion of intravenously administered silica nanoparticles of different sizes

作者: Xie, GP (Xie, Guangping); Sun, J (Sun, Jiao); Zhong, GR (Zhong, Gaoren)

来源出版物: JOURNAL OF NANOPARTICLE RESEARCH 卷: 14 期: 1 文献号: 671 DOI: 10.1007/s11051-011-0671-x 出版年: JAN 2012

第 35 条，共 44 条

标题: Titanium dioxide in our everyday life; is it safe?

作者: Skocaj, M (Skocaj, Matej); Filipic, M (Filipic, Metka); Petkovic, J (Petkovic, Jana); Novak, S (Novak, Sasa)

来源出版物: RADIOLOGY AND ONCOLOGY 卷: 45 期: 4 页: 227-247 DOI: 10.2478/v10019-011-0037-0 出版年: DEC 2011

第 36 条，共 44 条

标题: Correlation of the Cytotoxicity of TiO2 Nanoparticles with Different Particle Sizes on a Sub-200-nm Scale

作者: Cai, KY (Cai, Kaiyong); Hou, YH (Hou, Yanhua); Hu, Y (Hu, Yan); Zhao, L (Zhao, Li); Luo, Z (Luo, Zhong); Shi, YS (Shi, Yisong); Lai, M (Lai, Min); Yang, WH (Yang, Weihu); Liu, P (Liu, Peng)

来源出版物: SMALL 卷: 7 期: 21 页: 3026-3031 DOI: 10.1002/smll.201101170

出版年: NOV 4 2011

第 37 条，共 44 条

标题: The Electrostatic Interactions Between Nano-TiO2 and Trypsin Inhibit the Enzyme Activity and Change the Secondary Structure of Trypsin

作者: Wang, WR (Wang, Wen-Rui); Zhu, RR (Zhu, Rong-Rong); Xiao, R (Xiao, Rong); Liu, H (Liu, Hui); Wang, SL (Wang, Shi-Long)

来源出版物: BIOLOGICAL TRACE ELEMENT RESEARCH 卷: 142 期: 3 页: 435-446 DOI: 10.1007/s12011-010-8823-x 出版年: SEP 2011

第 38 条，共 44 条

标题: Analysis of the cytotoxicity of differentially sized titanium dioxide nanoparticles in murine MC3T3-E1 preosteoblasts

作者: Zhang, YL (Zhang, Yilin); Yu, WQ (Yu, Weiqiang); Jiang, XQ (Jiang, Xinquan); Lv, KG (Lv, Kaige); Sun, SJ (Sun, Shengjun); Zhang, FQ (Zhang, Fuqiang)

来源出版物: JOURNAL OF MATERIALS SCIENCE-MATERIALS IN MEDICINE 卷: 22 期: 8 页: 1933-1945 DOI: 10.1007/s10856-011-4375-7 出版年: AUG 2011

第 39 条，共 44 条

标题: Raman spectroscopic investigation on the microenvironment of the liver tissues of Zebrafish (Danio rerio) due to titanium dioxide exposure

作者: Palaniappan, PLRM (Palaniappan, P. L. R. M.); Pramod, KS (Pramod, K. S.)

来源出版物: VIBRATIONAL SPECTROSCOPY 卷: 56 期: 2 页: 146-153 DOI: 10.1016/j.vibspec.2011.01.005 出版年: JUL 18 2011

第 40 条，共 44 条

标题: Neuroprotective effect of Jatrorrhizine on hydrogen peroxide-induced cell injury and its potential mechanisms in PC12 cells

作者: Luo, T (Luo, Tao); Zhang, H (Zhang, Hui); Zhang, WW (Zhang, Wei-Wei); Huang, JT (Huang, Jun-Ting); Song, EL (Song, En-Lin); Chen, SG (Chen, Sheng-Guo); He, F (He, Feng); Xu, J (Xu, Jie); Wang, HQ (Wang, Hua-Qiao)

来源出版物: NEUROSCIENCE LETTERS 卷: 498 期: 3 页: 227-231 DOI: 10.1016/j.neulet.2011.05.017 出版年: JUL 12 2011

第 41 条，共 44 条

标题: The effect of titanium dioxide on the biochemical constituents of the brain of Zebrafish (Danio rerio): An FT-IR study

作者: Palaniappan, PR (Palaniappan, Pl. Rm.); Pramod, KS (Pramod, K. S.)

来源出版物: SPECTROCHIMICA ACTA PART A-MOLECULAR AND

BIOMOLECULAR SPECTROSCOPY 卷: 79 期: 1 页: 206-212 DOI: 10.1016/j.saa.2011.02.038 出版年: JUN 2011

第 42 条，共 44 条

标题: Efficacy of Pt-modified TiO2 nanoparticles in cardiac cells

作者: Mallik, A (Mallik, Adiel); Bryan, S (Bryan, Sean); Puukila, S (Puukila, Stephanie); Chen, AC (Chen, Aicheng); Khaper, N (Khaper, Neelam)

来源出版物: EXPERIMENTAL & CLINICAL CARDIOLOGY 卷: 16 期: 1 页: 6-10 出版年: SPR 2011

第 43 条，共 44 条

标题: Biomechanisms of Nanoparticles (Toxicants, Antioxidants and Therapeutics): Electron Transfer and Reactive Oxygen Species

作者: Kovacic, P (Kovacic, Peter); Somanathan, R (Somanathan, Ratnasamy)

来源出版物: JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 卷: 10 期: 12 页: 7919-7930 DOI: 10.1166/jnn.2010.3028 出版年: DEC 2010

第 44 条，共 44 条

标题: Induction of oxidative stress and apoptosis by silver nanoparticles in the liver of adult zebrafish

作者: Choi, JE (Choi, Ji Eun); Kim, S (Kim, Soohee); Ahn, JH (Ahn, Jin Hee); Youn, P (Youn, Pilju); Kang, JS (Kang, Jin Seok); Park, K (Park, Kwangsik); Yi, J (Yi, Jongheop); Ryu, DY (Ryu, Doug-Young)

来源出版物: AQUATIC TOXICOLOGY 卷: 100 期: 2 页: 151-159 DOI: 10.1016/j.aquatox.2009.12.012 出版年: OCT 15 2010

第 9 条，共 12 条

标题: Potential neurological lesion after nasal instillation of TiO2 nanoparticles in the anatase and rutile crystal phases

作者: Wang, JX (Wang, Jiangxue); Chen, CY (Chen, Chunying); Liu, Y (Liu, Ying); Jiao, F (Jiao, Fang); Li, W (Li, Wei); Lao, F (Lao, Fang); Li, YF (Li, Yufeng); Li, B (Li, Bai); Ge, CC (Ge, Cuicui); Zhou, GQ (Zhou, Guoqiang); Gao, YX (Gao, Yuxi); Zhao, YL (Zhao, Yuliang); Chai, ZF (Chai, Zhifang)

来源出版物: TOXICOLOGY LETTERS 卷: 183 期: 1-3 页: 72-80 DOI: 10.1016/j.toxlet.2008.10.001 出版年: DEC 15 2008

Web of Science 核心合集中的 "被引频次": 136

第 1 条，共 136 条

标题: In vitro screening of metal oxide nanoparticles for effects on neural function using cortical networks on microelectrode arrays
作者: Strickland, JD (Strickland, Jenna D.); Lefew, WR (Lefew, William R.); Crooks, J (Crooks, James); Hall, D (Hall, Diana); Ortenzio, JNR (Ortenzio, Jayna N. R.); Dreher, K (Dreher, Kevin); Shafer, TJ (Shafer, Timothy J.)
来源出版物: NANOTOXICOLOGY 卷: 10 期: 5 页: 619-628 DOI: 10.3109/17435390.2015.1107142 出版年: MAY 27 2016
第 2 条，共 136 条
标题: Respiratory tract toxicity of titanium dioxide nanoparticles and multi-walled carbon nanotubes on mice after intranasal exposure
作者: Sukwong, P (Sukwong, Patinya); Somkid, K (Somkid, Koravit); Kongseng, S (Kongseng, Supunsa); Pissuwan, D (Pissuwan, Dakrong); Yoovathaworn, K (Yoovathaworn, Krongtong)
来源出版物: MICRO & NANO LETTERS 卷: 11 期: 4 页: 183-187 DOI: 10.1049/mnl.2015.0523 出版年: APR 2016
第 3 条，共 136 条
标题: Murine liver damage caused by exposure to nano-titanium dioxide
作者: Hong, J (Hong, Jie); Zhang, YQ (Zhang, Yu-Qing)
来源出版物: NANOTECHNOLOGY 卷: 27 期: 11 文献号: 112001 DOI: 10.1088/0957-4484/27/11/112001 出版年: MAR 18 2016
第 4 条，共 136 条
标题: The effects of exposure to titanium dioxide nanoparticles during lactation period on learning and memory of rat offspring
作者: Mohammadipour, A (Mohammadipour, Abbas); Hosseini, M (Hosseini, Mahmoud); Fazel, A (Fazel, Alireza); Haghir, H (Haghir, Hossein); Rafatpanah, H (Rafatpanah, Houshang); Pourganji, M (Pourganji, Masoume); Bideskan, AE (Bideskan, Alireza Ebrahimzadeh)
来源出版物: TOXICOLOGY AND INDUSTRIAL HEALTH 卷: 32 期: 2 页: 221-228 DOI: 10.1177/0748233713498440 出版年: FEB 2016
第 5 条，共 136 条
标题: Biomedical applications of nano-titania in theranostics and photodynamic therapy
作者: Rehman, FU (Rehman, F. U.); Zhao, C (Zhao, C.); Jiang, H (Jiang, H.); Wang, X (Wang, X.)
来源出版物: BIOMATERIALS SCIENCE 卷: 4 期: 1 页: 40-54 DOI: 10.1039/c5bm00332f 出版年: 2016

第 6 条，共 136 条

标题: TiO2 nanoparticles-induced apoptosis of primary cultured Sertoli cells of mice

作者: Hong, FS (Hong, Fashui); Zhao, XY (Zhao, Xiaoyang); Chen, M (Chen, Ming); Zhou, YJ (Zhou, Yingjun); Ze, YG (Ze, Yuguan); Wang, L (Wang, Ling); Wang, YJ (Wang, Yajing); Ge, YS (Ge, Yushuang); Zhang, Q (Zhang, Qi); Ye, LQ (Ye, Lingqun)

来源出版物: JOURNAL OF BIOMEDICAL MATERIALS RESEARCH PART A 卷: 104 期: 1 页: 124-135 DOI: 10.1002/jbm.a.35548 出版年: JAN 2016

第 7 条，共 136 条

标题: Tissue biodistribution of intravenously administrated titanium dioxide nanoparticles revealed blood-brain barrier clearance and brain inflammation in rat

作者: Disdier, C (Disdier, Clemence); Devoy, J (Devoy, Jerome); Cosnefroy, A (Cosnefroy, Anne); Chalansonnet, M (Chalansonnet, Monique); Herlin-Boime, N (Herlin-Boime, Nathalie); Brun, E (Brun, Emilie); Lund, A (Lund, Amie); Mabondzo, A (Mabondzo, Aloise)

来源出版物: PARTICLE AND FIBRE TOXICOLOGY 卷: 12 文献号: 27 DOI: 10.1186/s12989-015-0102-8 出版年: SEP 4 2015

第 8 条，共 136 条

标题: Raman microspectroscopy of exhaled breath condensate and urine in workers exposed to fine and nano TiO2 particles: a cross-sectional study

作者: Pelclova, D (Pelclova, Daniela); Barosova, H (Barosova, Hana); Kukutschova, J (Kukutschova, Jana); Zdimal, V (Zdimal, Vladimir); Navratil, T (Navratil, Tomas); Fenclova, Z (Fenclova, Zdenka); Vlckova, S (Vlckova, Stepanka); Schwarz, J (Schwarz, Jaroslav); Zikova, N (Zikova, Nadezda); Kacer, P (Kacer, Petr); Komarc, M (Komarc, Martin); Belacek, J (Belacek, Jaroslav); Zakharov, S (Zakharov, Sergey)

来源出版物: JOURNAL OF BREATH RESEARCH 卷: 9 期: 3 文献号: 036008 DOI: 10.1088/1752-7155/9/3/036008 出版年: SEP 2015

第 9 条，共 136 条

标题: A review on potential neurotoxicity of titanium dioxide nanoparticles

作者: Song, B (Song, Bin); Liu, J (Liu, Jia); Feng, XL (Feng, Xiaoli); Wei, M (Wei, Limin); Shao, LQ (Shao, Longquan)

来源出版物: NANOSCALE RESEARCH LETTERS 卷: 10 文献号: 342 DOI: 10.1186/s11671-015-1042-9 出版年: AUG 26 2015

第 10 条，共 136 条

标题: Nanosized TiO2 is internalized by dorsal root ganglion cells and causes damage via apoptosis

作者: Erriquez, J (Erriquez, Jessica); Bolis, V (Bolis, Vera); Morel, S (Morel, Silvia); Fenoglio, I (Fenoglio, Ivana); Fubini, B (Fubini, Bice); Quagliotto, P (Quagliotto, Pierluigi); Distasi, C (Distasi, Carla)

来源出版物: Nanomedicine-Nanotechnology Biology and Medicine 卷: 11 期: 6 页: 1309-1319 DOI: 10.1016/j.nano.2015.04.003 出版年: AUG 2015

第 11 条，共 136 条

标题: Toxicity of titanium dioxide nanoparticles in central nervous system

作者: Czajka, M (Czajka, Magdalena); Sawicki, K (Sawicki, Krzysztof); Sikorska, K (Sikorska, Katarzyna); Popek, S (Popek, Sylwia); Kruszewski, M (Kruszewski, Marcin); Kapka-Skrzypczak, L (Kapka-Skrzypczak, Lucyna)

来源出版物: TOXICOLOGY IN VITRO 卷: 29 期: 5 页: 1042-1052 DOI: 10.1016/j.tiv.2015.04.004 出版年: AUG 2015

第 12 条，共 136 条

标题: Role of Carnosine and Melatonin in Ameliorating Cardiotoxicity of Titanium Dioxide Nanoparticles in the Rats

作者: Al-Rasheed, N (Al-Rasheed, Nouf); Faddah, L (Faddah, Laila); Ibrahim, H (Ibrahim, Hanan); Mohamed, AM (Mohamed, Azza M.); Al-Rasheed, N (Al-Rasheed, Nawal); Abdelbaky, N (Abdelbaky, Nayira)

来源出版物: BRAZILIAN ARCHIVES OF BIOLOGY AND TECHNOLOGY 卷: 58 期: 4 页: 577-586 DOI: 10.1590/S1516-89132015000014 出版年: JUL-AUG 2015

第 13 条，共 136 条

标题: Mitochondrial dysfunction in titanium dioxide nanoparticle-induced neurotoxicity

作者: Nalika, N (Nalika, Nandini); Parvez, S (Parvez, Suhel)

来源出版物: TOXICOLOGY MECHANISMS AND METHODS 卷: 25 期: 5 页: 355-363 DOI: 10.3109/15376516.2015.1020183 出版年: JUN 13 2015

第 14 条，共 136 条

标题: Subacute toxicity of titanium dioxide (TiO2) nanoparticles in male rats: emotional behavior and pathophysiological examination

作者: Ben Younes, NR (Ben Younes, Naima Rihane); Amara, S (Amara, Salem); Mrad, I (Mrad, Imen); Ben-Slama, I (Ben-Slama, Imen); Jeljeli, M (Jeljeli, Mustapha); Omri, K (Omri, Karim); El Ghoul, J (El Ghoul, Jaber); El Mir, L (El Mir, Lassaad); Ben Rhouma, K (Ben Rhouma, Khemais); Abdelmelek, H (Abdelmelek, Hafedh); Sakly, M (Sakly, Mohsen)

来源出版物: ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH 卷: 22 期: 11 页: 8728-8737 DOI: 10.1007/s11356-014-4002-5 出版年: JUN 2015

第 15 条，共 136 条

标题: Suppression of neurite outgrowth of primary cultured hippocampal neurons is involved in impairment of glutamate metabolism and NMDA receptor function caused by nanoparticulate TiO2

作者: Hong, FS (Hong, Fashui); Sheng, L (Sheng, Lei); Ze, YG (Ze, Yuguan); Hong, J (Hong, Jie); Zhou, YJ (Zhou, Yingjun); Wang, L (Wang, Ling); Liu, D (Liu, Dong); Yu, XH (Yu, Xiaohong); Xu, BQ (Xu, Bingqing); Zhao, XY (Zhao, Xiaoyang); Ze, X (Ze, Xiao)

来源出版物: BIOMATERIALS 卷: 53 页: 76-85 DOI: 10.1016/j.biomaterials.2015.02.067 出版年: JUN 2015

第 16 条，共 136 条

标题: Quantitative evaluation of the pulmonary microdistribution of TiO2 nanoparticles using X-ray fluorescence microscopy after intratracheal administration with a microsprayer in rats

作者: Zhang, GH (Zhang, Guihua); Shinohara, N (Shinohara, Naohide); Kano, H (Kano, Hirokazu); Senoh, H (Senoh, Hideki); Suzuki, M (Suzuki, Masaaki); Sasaki, T (Sasaki, Takeshi); Fukushima, S (Fukushima, Shoji); Gamo, M (Gamo, Masashi)

来源出版物: JOURNAL OF APPLIED TOXICOLOGY 卷: 35 期: 6 页: 623-630 DOI: 10.1002/jat.3109 出版年: JUN 2015

第 17 条，共 136 条

标题: Comparative cellular toxicity of titanium dioxide nanoparticles on human astrocyte and neuronal cells after acute and prolonged exposure

作者: Coccini, T (Coccini, Teresa); Grandi, S (Grandi, Stefania); Lonati, D (Lonati, Davide); Locatelli, C (Locatelli, Carlo); De Simone, U (De Simone, Uliana)

来源出版物: NEUROTOXICOLOGY 卷: 48 页: 77-89 DOI: 10.1016/j.neuro.2015.03.006 出版年: MAY 2015

第 18 条，共 136 条

标题: Using physiologically based pharmacokinetic (PBPK) modeling for dietary risk assessment of titanium dioxide (TiO2) nanoparticles

作者: Bachler, G (Bachler, Gerald); von Goetz, N (von Goetz, Natalie); Hungerbuhler, K (Hungerbuhler, Konrad)

来源出版物: NANOTOXICOLOGY 卷: 9 期: 3 页: 373-380 DOI: 10.3109/17435390.2014.940404 出版年: MAY 2015

第 19 条，共 136 条

标题: Alternating Magnetic Field-Induced Hyperthermia Increases Iron Oxide Nanoparticle Cell Association/Uptake and Flux in Blood-Brain Barrier Models

作者: Dan, M (Dan, Mo); Bae, Y (Bae, Younsoo); Pittman, TA (Pittman, Thomas A.); Yokel,

RA (Yokel, Robert A.)
来源出版物: PHARMACEUTICAL RESEARCH 卷: 32 期: 5 页: 1615-1625 DOI: 10.1007/s11095-014-1561-6 出版年: MAY 2015
第 20 条，共 136 条
标题: Titanium Nanoparticle Inhalation Induces Renal Fibrosis in Mice via an Oxidative Stress Upregulated Transforming Growth Factor-beta Pathway
作者: Huang, KT (Huang, Kuo-Tong); Wu, CT (Wu, Cheng-Tien); Huang, KH (Huang, Kuo-How); Lin, WC (Lin, Wei-Chou); Chen, CM (Chen, Chang-Mu); Guan, SS (Guan, Siao-Syun); Chiang, CK (Chiang, Chih-Kang); Liu, SH (Liu, Shing-Hwa)
来源出版物: CHEMICAL RESEARCH IN TOXICOLOGY 卷: 28 期: 3 特刊: SI 页: 354-364 DOI: 10.1021/tx500287f 出版年: MAR 2015
第 21 条，共 136 条
标题: Mechanisms of TiO2 nanoparticle-induced neuronal apoptosis in rat primary cultured hippocampal neurons
作者: Sheng, L (Sheng, Lei); Ze, YG (Ze, Yuguan); Wang, L (Wang, Ling); Yu, XH (Yu, Xiaohong); Hong, J (Hong, Jie); Zhao, XY (Zhao, Xiaoyang); Ze, X (Ze, Xiao); Liu, D (Liu, Dong); Xu, BQ (Xu, Bingqing); Zhu, Y (Zhu, Yunting); Long, Y (Long, Yi); Lin, AA (Lin, Anan); Zhang, C (Zhang, Chi); Zhao, Y (Zhao, Yue); Hong, FH (Hong, Fashui)
来源出版物: JOURNAL OF BIOMEDICAL MATERIALS RESEARCH PART A 卷: 103 期: 3 页: 1141-1149 DOI: 10.1002/jbm.a.35263 出版年: MAR 2015
第 22 条，共 136 条
标题: Toxicological Characteristics of Titanium Dioxide Nanoparticle in Rats
作者: Chang, XH (Chang, Xuhong); Xie, YX (Xie, Yanxin); Wu, JR (Wu, Jianru); Tang, M (Tang, Meng); Wang, B (Wang, Bei)
来源出版物: JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 卷: 15 期: 2 页: 1135-1142 DOI: 10.1166/jnn.2015.8998 出版年: FEB 2015
第 23 条，共 136 条
标题: Nanoparticles, Neurotoxicity and Neurodegenerative Diseases
作者: Mushtaq, G (Mushtaq, Gohar); Khan, JA (Khan, Jalaluddin A.); Joseph, E (Joseph, Ebenezer); Kamal, MA (Kamal, Mohammad A.)
来源出版物: CURRENT DRUG METABOLISM 卷: 16 期: 8 页: 676-684 出版年: 2015
第 24 条，共 136 条
标题: Toxicity of engineered metal oxide nanomaterials mediated by nano-bio-eco-interactions: a review and perspective

作者: He, XJ (He, Xiaojia); Aker, WG (Aker, Winfred G.); Fu, PP (Fu, Peter P.); Hwang, HM (Hwang, Huey-Min)

来源出版物: ENVIRONMENTAL SCIENCE-NANO 卷: 2 期: 6 页: 564-582 DOI: 10.1039/c5en00094g 出版年: 2015

第 25 条，共 136 条

标题: Mitochondrial dysfunction and loss of glutamate uptake in primary astrocytes exposed to titanium dioxide nanoparticles

作者: Wilson, CL (Wilson, Christina L.); Natarajan, V (Natarajan, Vaishaali); Hayward, SL (Hayward, Stephen L.); Khalimonchuk, O (Khalimonchuk, Oleh); Kidambi, S (Kidambi, Srivatsan)

来源出版物: NANOSCALE 卷: 7 期: 44 页: 18477-18488 DOI: 10.1039/c5nr03646a 出版年: 2015

第 26 条，共 136 条

标题: Assessing the axonal translocation of CeO2 and SiO2 nanoparticles in the sciatic nerve fibers of the frog: an ex vivo electrophysiological study

作者: Kastrinaki, G (Kastrinaki, Georgia); Samsouris, C (Samsouris, Christos); Kosmidis, EK (Kosmidis, Efstratios K.); Papaioannou, E (Papaioannou, Eleni); Konstandopoulos, AG (Konstandopoulos, Athanasios G.); Theophilidis, G (Theophilidis, George)

来源出版物: INTERNATIONAL JOURNAL OF NANOMEDICINE 卷: 10 页: 7089-7096 DOI: 10.2147/IJN.S93663 出版年: 2015

第 27 条，共 136 条

标题: Cytotoxicity of TiO2 nanoparticles to mussel hemocytes and gill cells in vitro: Influence of synthesis method, crystalline structure, size and additive

作者: Katsumiti, A (Katsumiti, Alberto); Berhanu, D (Berhanu, Deborah); Howard, KT (Howard, Kieren T.); Arostegui, I (Arostegui, Inmaculada); Oron, M (Oron, Miriam); Reip, P (Reip, Paul); Valsami-Jones, E (Valsami-Jones, Eugenia); Cajaraville, MP (Cajaraville, Miren P.)

来源出版物: NANOTOXICOLOGY 卷: 9 期: 5 页: 543-553 DOI: 10.3109/17435390.2014.952362 出版年: 2015

第 28 条，共 136 条

标题: Central nervous system toxicity of metallic nanoparticles

作者: Feng, XL (Feng, Xiaoli); Chen, AJ (Chen, Aijie); Zhang, YL (Zhang, Yanli); Wang, JF (Wang, Jianfeng); Shao, LQ (Shao, Longquan); Wei, LM (Wei, Limin)

来源出版物: INTERNATIONAL JOURNAL OF NANOMEDICINE 卷: 10 页: 4321-4340 DOI: 10.2147/IJN.S78308 出版年: 2015

第 29 条，共 136 条

标题：LIPID PEROXIDATION AND PROTEIN OXIDATION INDUCED BY DIFFERENT NANOPARTICLES IN ZEBRAFISH ORGANS

作者: Carrillo, Y (Carrillo, Y.); Torres-Duarte, C (Torres-Duarte, C.); Oviedo, MJ (Oviedo, M. J.); Hirata, GA (Hirata, G. A.); Huerta-Saquero, A (Huerta-Saquero, A.); Vazquez-Duhalt, R (Vazquez-Duhalt, R.)

来源出版物: APPLIED ECOLOGY AND ENVIRONMENTAL RESEARCH 卷: 13 期: 3 页: 709-723 出版年: 2015

第 30 条，共 136 条

标题: Involvement of neurotrophins and related signaling genes in TiO2 nanoparticle - induced inflammation in the hippocampus of mice

作者: Su, MY (Su, Mingyu); Sheng, L (Sheng, Lei); Zhao, XY (Zhao, Xiaoyang); Wang, L (Wang, Ling); Yu, XH (Yu, Xiaohong); Hong, J (Hong, Jie); Xu, BQ (Xu, Bingqing); Liu, D (Liu, Dong); Jiang, H (Jiang, Hao); Ze, X (Ze, Xiao); Zhu, YT (Zhu, Yunting); Long, Y (Long, Yi); Zhou, JL (Zhou, Junling); Cui, JW (Cui, Jingwen); Li, K (Li, Kai); Ze, YG (Ze, Yuguan); Hong, FS (Hong, Fashui)

来源出版物: TOXICOLOGY RESEARCH 卷: 4 期: 2 页: 344-350 DOI: 10.1039/c4tx00106k 出版年: 2015

第 31 条，共 136 条

标题: Nanosurface chemistry and dose govern the bioaccumulation and toxicity of carbon nanotubes, metal nanomaterials and quantum dots in vivo

作者: Zhao, F (Zhao, Feng); Meng, H (Meng, Huan); Yan, L (Yan, Liang); Wang, B (Wang, Bing); Zhao, YL (Zhao, Yuliang)

来源出版物: SCIENCE BULLETIN 卷: 60 期: 1 页: 3-20 DOI: 10.1007/s11434-014-0700-0 出版年: JAN 2015

第 32 条，共 136 条

标题: Assessment of ZnO and SiO2 nanoparticle permeability through and toxicity to the blood-brain barrier using Evans blue and TEM

作者: Shim, KH (Shim, Kyu Hwan); Jeong, KH (Jeong, Kyeong-Hoon); Bae, SO (Bae, Sun Oh); Kang, MO (Kang, Min O.); Maeng, EH (Maeng, Eun Ho); Choi, CS (Choi, Cheol Soo); Kim, YR (Kim, Yu-Ri); Hulme, J (Hulme, John); Lee, EK (Lee, Eun Kyu); Kim, MK (Kim, Meyoung-Kon); An, SSA (An, Seong Soo A.)

来源出版物: INTERNATIONAL JOURNAL OF NANOMEDICINE 卷: 9 页: 225-233 DOI: 10.2147/IJN.S58205 增刊: 2 出版年: DEC 15 2014

第 33 条，共 136 条

标题: Phoxim-Induced Damages of Bombyx mori Larval Midgut and Titanium Dioxide Nanoparticles Protective Role Under Phoxim-Induced Toxicity
作者: Su, JJ (Su, Junju); Li, B (Li, Bing); Cheng, S (Cheng, Shen); Zhu, Z (Zhu, Zhou); Sang, XZ (Sang, Xuezi); Gui, SX (Gui, Suxin); Xie, Y (Xie, Yi); Sun, QQ (Sun, Qingqing); Cheng, Z (Cheng, Zhe); Cheng, J (Cheng, Jie); Hu, RP (Hu, Rengping); Shen, WD (Shen, Weide); Xia, QY (Xia, Qingyou); Zhao, P (Zhao, Ping); Hong, FS (Hong, Fashui)
来源出版物: ENVIRONMENTAL TOXICOLOGY 卷: 29 期: 12 页: 1355-1366 DOI: 10.1002/tox.21866 出版年: DEC 2014
第 34 条，共 136 条
标题: Granular biodurable nanomaterials: No convincing evidence for systemic toxicity
作者: Moreno-Horn, M (Moreno-Horn, Marcus); Gebel, T (Gebel, Thomas)
来源出版物: CRITICAL REVIEWS IN TOXICOLOGY 卷: 44 期: 10 页: 849-875 DOI: 10.3109/10408444.2014.938802 出版年: NOV 2014
第 35 条，共 136 条
标题: Lung Toxicity of Biodegradable Nanoparticles
作者: Fattal, E (Fattal, Elias); Grabowski, N (Grabowski, Nadege); Mura, S (Mura, Simona); Vergnaud, J (Vergnaud, Juliette); Tsapis, N (Tsapis, Nicolas); Hillaireau, H (Hillaireau, Herve)
来源出版物: JOURNAL OF BIOMEDICAL NANOTECHNOLOGY 卷: 10 期: 10 特刊: SI 页: 2852-2864 DOI: 10.1166/jbn.2014.1939 出版年: OCT 2014
第 36 条，共 136 条
标题: Engineered nanoparticles. How brain friendly is this new guest?
作者: Cupaioli, FA (Cupaioli, Francesca A.); Zucca, FA (Zucca, Fabio A.); Boraschi, D (Boraschi, Diana); Zecca, L (Zecca, Luigi)
来源出版物: PROGRESS IN NEUROBIOLOGY 卷: 119 页: 20-38 DOI: 10.1016/j.pneurobio.2014.05.002 出版年: AUG-SEP 2014
第 37 条，共 136 条
标题: An in vivo study on the photo-enhanced toxicities of S-doped TiO2 nanoparticles to zebrafish embryos (Danio rerio) in terms of malformation, mortality, rheotaxis dysfunction, and DNA damage
作者: He, XJ (He, Xiaojia); Aker, WG (Aker, Winfred G.); Hwang, HM (Hwang, Huey-Min)
来源出版物: NANOTOXICOLOGY 卷: 8 页: 185-195 DOI: 10.3109/17435390.2013.874050 增刊: 1 出版年: AUG 2014

第 38 条，共 136 条

标题: Health hazards associated with nanomaterials

作者: Pattan, G (Pattan, Gurulingappa); Kaul, G (Kaul, Gautam)

来源出版物: TOXICOLOGY AND INDUSTRIAL HEALTH 卷: 30 期: 6 页: 499-519 DOI: 10.1177/0748233712459900 出版年: JUL 2014

第 39 条，共 136 条

标题: Manipulation of isolated brain nerve terminals by an external magnetic field using D-mannose-coated gamma-Fe2O3 nano-sized particles and assessment of their effects on glutamate transport

作者: Borisova, T (Borisova, Tatiana); Krisanova, N (Krisanova, Natalia); Borysov, A (Borysov, Arsenii); Sivko, R (Sivko, Roman); Ostapchenko, L (Ostapchenko, Ludmila); Babic, M (Babic, Michal); Horak, D (Horak, Daniel)

来源出版物: BEILSTEIN JOURNAL OF NANOTECHNOLOGY 卷: 5 页: 778-788 DOI: 10.3762/bjnano.5.90 出版年: JUN 4 2014

第 40 条，共 136 条

标题: Effects of Feeding Silkworm with Nanoparticulate Anatase TiO2 (TiO2 NPs) on Its Feed Efficiency!

作者: Zhang, H (Zhang, Hua); Ni, M (Ni, Min); Li, FC (Li, Fanchi); Xu, KZ (Xu, Kaizun); Wang, BB (Wang, Binbin); Hong, FS (Hong, Fashui); Shen, WD (Shen, Weide); Li, B (Li, Bing)

来源出版物: BIOLOGICAL TRACE ELEMENT RESEARCH 卷: 159 期: 1-3 页: 224-232 DOI: 10.1007/s12011-014-9986-7 出版年: JUN 2014

第 41 条，共 136 条

标题: Life-cycle assessment of engineered nanomaterials: a literature review of assessment status

作者: Miseljic, M (Miseljic, Mirko); Olsen, SI (Olsen, Stig I.)

来源出版物: JOURNAL OF NANOPARTICLE RESEARCH 卷: 16 期: 6 文献号: 2427 DOI: 10.1007/s11051-014-2427-x 出版年: MAY 24 2014

第 42 条，共 136 条

标题: Aerosol deposition in nasal passages of burrowing and ground rodents when breathing dust-laden air

作者: Moshkin, MP (Moshkin, M. P.); Petrovski, DV (Petrovski, D. V.); Akulov, AE (Akulov, A. E.); Romaschenko, AV (Romaschenko, A. V.); Gerlinskaya, LA (Gerlinskaya, L. A.); Muchnaya, MI (Muchnaya, M. I.); Ganimedov, VL (Ganimedov, V. L.); Sadovsky, AS (Sadovsky, A. S.); Savelov, AA (Savelov, A. A.); Koptyug, IV (Koptyug, I. V.); Troitsky, SY

(Troitsky, S. Yu.); Bukhtiyarov, VI (Bukhtiyarov, V. I.); Kolchanov, NA (Kolchanov, N. A.); Sagdeyev, RZ (Sagdeyev, R. Z.); Fomin, VM (Fomin, V. M.)
来源出版物: ZHURNAL OBSHCHEI BIOLOGII 卷: 75 期: 3 页: 214-225 出版年: MAY-JUN 2014
第 43 条，共 136 条
标题: Synchrotron-based X-ray microscopic studies for bioeffects of nanomaterials
作者: Zhu, Y (Zhu, Ying); Cai, XQ (Cai, Xiaoqing); Li, J (Li, Jiang); Zhong, ZT (Zhong, Zengtao); Huang, Q (Huang, Qing); Fan, CH (Fan, Chunhai)
来源出版物: NANOMEDICINE-NANOTECHNOLOGY BIOLOGY AND MEDICINE 卷: 10 期: 3 页: 515-524 DOI: 10.1016/j.nano.2013.11.005 出版年: APR 2014
第 44 条，共 136 条
标题: TiO2 Nanoparticles Induced Hippocampal Neuroinflammation in Mice
作者: Ze, YG (Ze, Yuguan); Sheng, L (Sheng, Lei); Zhao, XY (Zhao, Xiaoyang); Hong, J (Hong, Jie); Ze, X (Ze, Xiao); Yu, XH (Yu, Xiaohong); Pan, XY (Pan, Xiaoyu); Lin, A (Lin, Anan); Zhao, Y (Zhao, Yue); Zhang, C (Zhang, Chi); Zhou, QP (Zhou, Qiuping); Wang, L (Wang, Ling); Hong, FS (Hong, Fashui)
来源出版物: PLOS ONE 卷: 9 期: 3 文献号: e92230 DOI: 10.1371/journal.pone.0092230 出版年: MAR 21 2014
第 45 条，共 136 条
标题: Neurotoxicity of nanoscale materials
作者: Karmakar, A (Karmakar, Alokita); Zhang, QL (Zhang, Qinli); Zhang, YB (Zhang, Yongbin)
来源出版物: JOURNAL OF FOOD AND DRUG ANALYSIS 卷: 22 期: 1 特刊: SI 页: 147-160 DOI: 10.1016/j.jfda.2014.01.012 出版年: MAR 2014
第 46 条，共 136 条
标题: Multiwalled Carbon Nanotubes Hinder Microglia Function Interfering with Cell Migration and Phagocytosis
作者: Villegas, JC (Villegas, Juan C.); Alvarez-Montes, L (Alvarez-Montes, Laura); Rodriguez-Fernandez, L (Rodriguez-Fernandez, Lidia); Gonzalez, J (Gonzalez, Jesus); Valiente, R (Valiente, Rafael); Fanarraga, ML (Fanarraga, Monica L.)
来源出版物: ADVANCED HEALTHCARE MATERIALS 卷: 3 期: 3 页: 424-432 DOI: 10.1002/adhm.201300178 出版年: MAR 2014
第 47 条，共 136 条
标题: Tissue distribution and clearance of intravenously administered titanium dioxide (TiO2) nanoparticles

作者: Shinohara, N (Shinohara, Naohide); Danno, N (Danno, Nobuko); Ichinose, T (Ichinose, Takayuki); Sasaki, T (Sasaki, Takeshi); Fukui, H (Fukui, Hiroko); Honda, K (Honda, Kazumasa); Gamo, M (Gamo, Masashi)
来源出版物: NANOTOXICOLOGY 卷: 8 期: 2 页: 132-141 DOI: 10.3109/17435390.2012.763001 出版年: MAR 2014
第 48 条，共 136 条
标题: Toxicity assessment of TiO2 nanoparticles in zebrafish embryos under different exposure conditions
作者: Clemente, Z (Clemente, Z.); Castro, VLSS (Castro, V. L. S. S.); Moura, MAM (Moura, M. A. M.); Jonsson, CM (Jonsson, C. M.); Fraceto, LF (Fraceto, L. F.)
来源出版物: AQUATIC TOXICOLOGY 卷: 147 页: 129-139 DOI: 10.1016/j.aquatox.2013.12.024 出版年: FEB 2014
第 49 条，共 136 条
标题: Nano-Evaluris: an inhalation and explosion risk evaluation method for nanoparticle use. Part I: description of the methodology
作者: Bouillard, JX (Bouillard, Jacques X.); Vignes, A (Vignes, Alexis)
来源出版物: JOURNAL OF NANOPARTICLE RESEARCH 卷: 16 期: 2 文献号: 2149 DOI: 10.1007/s11051-013-2149-5 出版年: FEB 1 2014
第 50 条，共 136 条
标题: Neurotoxicity and gene-expressed profile in brain-injured mice caused by exposure to titanium dioxide nanoparticles
作者: Ze, YG (Ze, Yuguan); Hu, RP (Hu, Renping); Wang, XC (Wang, Xiaochun); Sang, XZ (Sang, Xuezi); Ze, X (Ze, Xiao); Li, B (Li, Bi); Su, JJ (Su, Junju); Wang, Y (Wang, Yuan); Guan, N (Guan, Ning); Zhao, XY (Zhao, Xiaoyang); Gui, SX (Gui, Suxin); Zhu, LY (Zhu, Liyuan); Cheng, Z (Cheng, Zhe); Cheng, J (Cheng, Jie); Sheng, L (Sheng, Lei); Sun, QQ (Sun, Qingqing); Wang, L (Wang, Ling); Hong, FS (Hong, Fashui)
来源出版物: JOURNAL OF BIOMEDICAL MATERIALS RESEARCH PART A 卷: 102 期: 2 页: 470-478 DOI: 10.1002/jbm.a.34705 出版年: FEB 2014
第 51 条，共 136 条
标题: A weight of evidence approach for hazard screening of engineered nanomaterials
作者: Hristozov, DR (Hristozov, Danail R.); Zabeo, A (Zabeo, Alex); Foran, C (Foran, Christy); Isigonis, P (Isigonis, Panagiotis); Critto, A (Critto, Andrea); Marcomini, A (Marcomini, Antonio); Linkov, I (Linkov, Igor)
来源出版物: NANOTOXICOLOGY 卷: 8 期: 1 页: 72-87 DOI: 10.3109/17435390.2012.750695 出版年: FEB 2014

第 52 条，共 136 条

标题: Neurotoxic characteristics of spatial recognition damage of the hippocampus in mice following subchronic peroral exposure to TiO2 nanoparticles

作者: Ze, YG (Ze, Yuguan); Sheng, L (Sheng, Lei); Zhao, XY (Zhao, Xiaoyang); Ze, X (Ze, Xiao); Wang, XC (Wang, Xuecen); Zhou, QP (Zhou, Qiuping); Liu, JL (Liu, Jialiang); Yuan, YF (Yuan, Yifei); Gui, SX (Gui, Suxin); Sang, XZ (Sang, Xuezi); Sun, QQ (Sun, Qingqing); Hong, J (Hong, Jie); Yu, XH (Yu, Xiaohong); Wang, L (Wang, Ling); Li, BY (Li, Bingyan); Hong, F (Hong, Fashui)

来源出版物: JOURNAL OF HAZARDOUS MATERIALS 卷: 264 页: 219-229 DOI: 10.1016/j.jhazmat.2013.10.072 出版年: JAN 15 2014

第 53 条，共 136 条

标题: Perturbation of physiological systems by nanoparticles

作者: Zhang, Y (Zhang, Yi); Bai, YH (Bai, Yuhong); Jia, JB (Jia, Jianbo); Gao, NN (Gao, Ningning); Li, Y (Li, Yang); Zhang, RN (Zhang, Ruinan); Jiang, GB (Jiang, Guibin); Yan, B (Yan, Bing)

来源出版物: CHEMICAL SOCIETY REVIEWS 卷: 43 期: 10 页: 3762-3809 DOI: 10.1039/c3cs60338e 出版年: 2014

第 54 条，共 136 条

标题: Toxicological Properties of Nanomaterials

作者: Zhang, MY (Zhang, Mingyi); Jin, JJ (Jin, Junjiang); Chang, YN (Chang, Ya-Nan); Chang, XL (Chang, Xueling); Xing, GM (Xing, Gengmei)

来源出版物: JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 卷: 14 期: 1 页: 717-729 DOI: 10.1166/jnn.2014.9198 出版年: JAN 2014

第 55 条，共 136 条

标题: Dispersion Method for Safety Research on Manufactured Nanomaterials

作者: Wu, WT (Wu, Wenting); Ichihara, G (Ichihara, Gaku); Suzuki, Y (Suzuki, Yuka); Izuoka, K (Izuoka, Kiyora); Oikawa-Tada, S (Oikawa-Tada, Saeko); Chang, J (Chang, Jie); Sakai, K (Sakai, Kiyoshi); Miyazawa, K (Miyazawa, Kunichi); Porter, D (Porter, Dale); Castranova, V (Castranova, Vincent); Kawaguchi, M (Kawaguchi, Masami); Ichihara, S (Ichihara, Sahoko)

来源出版物: INDUSTRIAL HEALTH 卷: 52 期: 1 页: 54-65 出版年: JAN 2014

第 56 条，共 136 条

标题: DNA Damage and Repair Following In Vitro Exposure to Two Different Forms of Titanium Dioxide Nanoparticles on Trout Erythrocyte

作者: Sekar, D (Sekar, Durairaj); Falcioni, ML (Falcioni, Maria Letizia); Barucca, G

(Barucca, Gianni); Falcioni, G (Falcioni, Giancarlo)
来源出版物: ENVIRONMENTAL TOXICOLOGY 卷: 29 期: 1 页: 117-127 DOI: 10.1002/tox.20778 出版年: JAN 2014
第 57 条，共 136 条
标题: NanoRiskCat: a conceptual tool for categorization and communication of exposure potentials and hazards of nanomaterials in consumer products
作者: Hansen, SF (Hansen, Steffen Foss); Jensen, KA (Jensen, Keld Alstrup); Baun, A (Baun, Anders)
来源出版物: JOURNAL OF NANOPARTICLE RESEARCH 卷: 16 期: 1 文献号: UNSP 2195 DOI: 10.1007/s11051-013-2195-z 出版年: DEC 27 2013
第 58 条，共 136 条
标题: Potential Impact of Quercetin and Idebenone against Immuno- inflammatory and Oxidative Renal Damage Induced in Rats by Titanium Dioxide Nanoparticles Toxicity
作者: Al-Rasheed, NM (Al-Rasheed, Nouf M.); Faddah, LM (Faddah, L. M.); Mohamed, AM (Mohamed, Azza M.); Baky, NAA (Baky, Nayira A. Abdel); Al-Rasheed, NM (Al-Rasheed, Nawal M.); Mohammad, RA (Mohammad, Raeesa A.)
来源出版物: JOURNAL OF OLEO SCIENCE 卷: 62 期: 11 页: 961-971 DOI: 10.5650/jos.62.961 出版年: NOV 2013
第 59 条，共 136 条
标题: TiO2 nanoparticles: a hidden enemy?
作者: Armand, L (Armand, Lucie); Biola-Clier, M (Biola-Clier, Mathilde); Rabilloud, T (Rabilloud, Thierry); Carriere, M (Carriere, Marie)
来源出版物: BIOFUTUR 期: 347 页: 42-45 出版年: OCT 2013
第 60 条，共 136 条
标题: Intranasal exposure to amorphous nanosilica particles could activate intrinsic coagulation cascade and platelets in mice
作者: Yoshida, T (Yoshida, Tokuyuki); Yoshioka, Y (Yoshioka, Yasuo); Tochigi, S (Tochigi, Saeko); Hirai, T (Hirai, Toshiro); Uji, M (Uji, Miyuki); Ichihashi, K (Ichihashi, Ko-ichi); Nagano, K (Nagano, Kazuya); Abe, Y (Abe, Yasuhiro); Kamada, H (Kamada, Haruhiko); Tsunoda, S (Tsunoda, Shin-ichi); Nabeshi, H (Nabeshi, Hiromi); Higashisaka, K (Higashisaka, Kazuma); Yoshikawa, T (Yoshikawa, Tomoaki); Tsutsumi, Y (Tsutsumi, Yasuo)
来源出版物: PARTICLE AND FIBRE TOXICOLOGY 卷: 10 文献号: UNSP 41 DOI: 10.1186/1743-8977-10-41 出版年: AUG 20 2013
第 61 条，共 136 条

标题：Titanium dioxide nanoparticle-induced testicular damage, spermatogenesis suppression, and gene expression alterations in male mice
作者: Gao, GD (Gao, Guodong); Ze, YG (Ze, Yuguan); Zhao, XY (Zhao, Xiaoyang); Sang, XZ (Sang, Xuezi); Zheng, L (Zheng, Lei); Ze, X (Ze, Xiao); Gui, SX (Gui, Suxin); Sheng, L (Sheng, Lei); Sun, QQ (Sun, Qingqing); Hong, J (Hong, Jie); Yu, XH (Yu, Xiaohong); Wang, L (Wang, Ling); Hong, FS (Hong, Fashui); Zhang, XG (Zhang, Xueguang)
来源出版物: JOURNAL OF HAZARDOUS MATERIALS 卷: 258 页: 133-143 DOI: 10.1016/j.jhazmat.2013.04.046 出版年: AUG 15 2013
第 62 条，共 136 条
标题: Role of the Toll Like Receptor (TLR) Radical Cycle in Chronic Inflammation: Possible Treatments Targeting the TLR4 Pathway
作者: Lucas, K (Lucas, Kurt); Maes, M (Maes, Michael)
来源出版物: MOLECULAR NEUROBIOLOGY 卷: 48 期: 1 页: 190-204 DOI: 10.1007/s12035-013-8425-7 出版年: AUG 2013
第 63 条，共 136 条
标题: Developmental Neurotoxicity of Engineered Nanomaterials: Identifying Research Needs to Support Human Health Risk Assessment
作者: Powers, CM (Powers, Christina M.); Bale, AS (Bale, Ambuja S.); Kraft, AD (Kraft, Andrew D.); Makris, SL (Makris, Susan L.); Trecki, J (Trecki, Jordan); Cowden, J (Cowden, John); Hotchkiss, A (Hotchkiss, Andrew); Gillespie, PA (Gillespie, Patricia A.)
来源出版物: TOXICOLOGICAL SCIENCES 卷: 134 期: 2 页: 225-242 DOI: 10.1093/toxsci/kft109 出版年: AUG 2013
第 64 条，共 136 条
标题: Comparative study on effects of two different types of titanium dioxide nanoparticles on human neuronal cells
作者: Valdiglesias, V (Valdiglesias, Vanessa); Costa, C (Costa, Carla); Sharma, V (Sharma, Vyom); Kilic, G (Kilic, Goezde); Pasaro, E (Pasaro, Eduardo); Teixeira, JP (Teixeira, Joao Paulo); Dhawan, A (Dhawan, Alok); Laffon, B (Laffon, Blanca)
来源出版物: FOOD AND CHEMICAL TOXICOLOGY 卷: 57 页: 352-361 DOI: 10.1016/j.fct.2013.04.010 出版年: JUL 2013
第 65 条，共 136 条
标题: Metal-based nanoparticle interactions with the nervous system: the challenge of brain entry and the risk of retention in the organism
作者: Yokel, R (Yokel, Robert); Grulke, E (Grulke, Eric); MacPhail, R (MacPhail, Robert)
来源出版物: WILEY INTERDISCIPLINARY REVIEWS-NANOMEDICINE AND

NANOBIOTECHNOLOGY 卷: 5 期: 4 页: 346-373 DOI: 10.1002/wnan.1202 出版年: JUL-AUG 2013

第 66 条，共 136 条

标题: The effect of primary particle size on biodistribution of inhaled gold nano-agglomerates

作者: Balasubramanian, SK (Balasubramanian, Suresh K.); Poh, KW (Poh, Kay-Wee); Ong, CN (Ong, Choon-Nam); Kreyling, WG (Kreyling, Wolfgang G.); Ong, WY (Ong, Wei-Yi); Yu, LE (Yu, Liya E.)

来源出版物: BIOMATERIALS 卷: 34 期: 22 页: 5439-5452 DOI: 10.1016/j.biomaterials.2013.03.080 出版年: JUL 2013

第 67 条，共 136 条

标题: Effect of TiO2 nanoparticles on emotional behavior and biochemical parameters in adult Wistar rats

作者: Amara, S (Amara, Salem); Khemissi, W (Khemissi, Wahid); Mrad, I (Mrad, Imen); Rihane, N (Rihane, Naima); Ben Slama, I (Ben Slama, Imen); El Mir, L (El Mir, Lassaad); Jeljeli, M (Jeljeli, Mustapha); Ben Rhouma, K (Ben Rhouma, Khemais); Abdelmelek, H (Abdelmelek, Hafedh); Sakly, M (Sakly, Mohsen)

来源出版物: GENERAL PHYSIOLOGY AND BIOPHYSICS 卷: 32 期: 2 页: 229-234 DOI: 10.4149/gpb_2013015 出版年: JUN 2013

第 68 条，共 136 条

标题: Interactions of Engineered Nanoparticles with Organs Protected by Internal Biological Barriers

作者: Pietroiusti, A (Pietroiusti, Antonio); Campagnolo, L (Campagnolo, Luisa); Fadeel, B (Fadeel, Bengt)

来源出版物: SMALL 卷: 9 期: 9-10 特刊: SI 页: 1557-1572 DOI: 10.1002/smll.201201463 出版年: MAY 27 2013

第 69 条，共 136 条

标题: Nanotoxicity: A Growing Need for Study in the Endocrine System

作者: Lu, XF (Lu, Xuefei); Liu, Y (Liu, Ying); Kong, XJ (Kong, Xiangjun); Lobie, PE (Lobie, Peter E.); Chen, CY (Chen, Chunying); Zhu, T (Zhu, Tao)

来源出版物: SMALL 卷: 9 期: 9-10 特刊: SI 页: 1654-1671 DOI: 10.1002/smll.201201517 出版年: MAY 27 2013

第 70 条，共 136 条

标题: Characterization and Preliminary Toxicity Assay of Nano-Titanium Dioxide Additive in Sugar-Coated Chewing Gum

作者: Chen, XX (Chen, Xin-Xin); Cheng, B (Cheng, Bin); Yang, YX (Yang, Yi-Xin); Cao, AN (Cao, Aoneng); Liu, JH (Liu, Jia-Hui); Du, LJ (Du, Li-Jing); Liu, YF (Liu, Yuanfang); Zhao, YL (Zhao, Yuliang); Wang, HF (Wang, Haifang)

来源出版物: SMALL 卷: 9 期: 9-10 特刊: SI 页: 1765-1774 DOI: 10.1002/smll.201201506 出版年: MAY 27 2013

第 71 条，共 136 条

标题: Titanium dioxide nanoparticles: a review of current toxicological data

作者: Shi, HB (Shi, Hongbo); Magaye, R (Magaye, Ruth); Castranova, V (Castranova, Vincent); Zhao, JS (Zhao, Jinshun)

来源出版物: PARTICLE AND FIBRE TOXICOLOGY 卷: 10 文献号: 15 DOI: 10.1186/1743-8977-10-15 出版年: APR 15 2013

第 72 条，共 136 条

标题: New vision to CuO, ZnO, and TiO2 nanoparticles: their outcome and effects

作者: Chibber, S (Chibber, Sandesh); Ansari, SA (Ansari, Shakeel Ahmed); Satar, R (Satar, Rukhsana)

来源出版物: JOURNAL OF NANOPARTICLE RESEARCH 卷: 15 期: 4 文献号: UNSP 1492 DOI: 10.1007/s11051-013-1492-x 出版年: APR 2013

第 73 条，共 136 条

标题: Inhalation of uranium nanoparticles: Respiratory tract deposition and translocation to secondary target organs in rats

作者: Petitot, F (Petitot, Fabrice); Lestaevel, P (Lestaevel, Philippe); Tourlonias, E (Tourlonias, Elie); Mazzucco, C (Mazzucco, Charline); Jacquinot, S (Jacquinot, Sebastien); Dhieux, B (Dhieux, Bernadette); Delissen, O (Delissen, Olivia); Tournier, BB (Tournier, Benjamin B.); Gensdarmes, F (Gensdarmes, Francois); Beaunier, P (Beaunier, Patricia); Dublineau, I (Dublineau, Isabelle)

来源出版物: TOXICOLOGY LETTERS 卷: 217 期: 3 页: 217-225 DOI: 10.1016/j.toxlet.2012.12.022 出版年: MAR 13 2013

第 74 条，共 136 条

标题: Metabolic effects of TiO2 nanoparticles, a common component of sunscreens and cosmetics, on human keratinocytes

作者: Tucci, P (Tucci, P.); Porta, G (Porta, G.); Agostini, M (Agostini, M.); Dinsdale, D (Dinsdale, D.); Iavicoli, I (Iavicoli, I.); Cain, K (Cain, K.); Finazzi-Agro, A (Finazzi-Agro, A.); Melino, G (Melino, G.); Willis, A (Willis, A.)

来源出版物: CELL DEATH & DISEASE 卷: 4 文献号: e549 DOI: 10.1038/cddis.2013.76 出版年: MAR 2013

第 75 条，共 136 条

标题: Molecular mechanisms underpinning laser printer and photocopier induced symptoms, including chronic fatigue syndrome and respiratory tract hyperresponsiveness: pharmacological treatment with Cinnamon and Hydrogen

作者: Lucas, K (Lucas, Kurt); Maes, M (Maes, Michael)

来源出版物: NEUROENDOCRINOLOGY LETTERS 卷: 34 期: 8 页: 723-737 出版年: 2013

第 76 条，共 136 条

标题: The Mutual Beneficial Effect between Medical Imaging and Nanomedicine

作者: Qiao, HT (Qiao, Huiting); Wang, LB (Wang, Libin); Han, JT (Han, Jintao); Chen, YM (Chen, Yingmao); Wang, DF (Wang, Daifa); Li, DY (Li, Deyu)

来源出版物: JOURNAL OF NANOMATERIALS 文献号: 764095 DOI: 10.1155/2013/764095 出版年: 2013

第 77 条，共 136 条

标题: Comparative study of neurologic effects of nano-TiO2 versus SiO2 after direct intracerebral exposure in mice

作者: Balvay, A (Balvay, A.); Thieriet, N (Thieriet, N.); Lakhdar, L (Lakhdar, L.); Bencsik, A (Bencsik, A.)

书籍团体作者: IOP

来源出版物: NANOSAFE 2012: INTERNATIONAL CONFERENCES ON SAFE PRODUCTION AND USE OF NANOMATERIALS 丛书: Journal of Physics Conference Series 卷: 429 出版年: 2013

第 78 条，共 136 条

标题: Characterization of cellular uptake and toxicity of aminosilane-coated iron oxide nanoparticles with different charges in central nervous system-relevant cell culture models

作者: Sun, ZZ (Sun, Zhizhi); Yathindranath, V (Yathindranath, Vinith); Worden, M (Worden, Matthew); Thliveris, JA (Thliveris, James A.); Chu, S (Chu, Stephanie); Parkinson, FE (Parkinson, Fiona E.); Hegmann, T (Hegmann, Torsten); Miller, DW (Miller, Donald W.)

来源出版物: INTERNATIONAL JOURNAL OF NANOMEDICINE 卷: 8 页: 961-970 DOI: 10.2147/IJN.S39048 出版年: 2013

第 79 条，共 136 条

标题: Neurotoxic potential of iron oxide nanoparticles in the rat brain striatum and hippocampus

作者: Wu, J (Wu, Jie); Ding, TT (Ding, Tingting); Sun, J (Sun, Jiao)
来源出版物: NEUROTOXICOLOGY 卷: 34 页: 243-253 DOI: 10.1016/j.neuro.2012.09.006 出版年: JAN 2013
第 80 条，共 136 条
标题: Photocatalytic and phototoxic properties of TiO2-based nanofilaments: ESR and AFM assays
作者: Pierzchala, K (Pierzchala, Katarzyna); Lekka, M (Lekka, Malgorzata); Magrez, A (Magrez, Arnaud); Kulik, AJ (Kulik, Andrzej J.); Forro, L (Forro, Laszlo); Sienkiewicz, A (Sienkiewicz, Andrzej)
来源出版物: NANOTOXICOLOGY 卷: 6 期: 8 页: 813-824 DOI: 10.3109/17435390.2011.625129 出版年: DEC 2012
第 81 条，共 136 条
标题: Biomedical Applications and Adverse Health Effects of Nanomaterials
作者: Shi, YC (Shi, Yanchao); Li, XY (Li, Xiaoyi)
来源出版物: JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 卷: 12 期: 11 页: 8231-8240 DOI: 10.1166/jnn.2012.6631 出版年: NOV 2012
第 82 条，共 136 条
标题: Involvement of reactive oxygen species and high-voltage-activated calcium currents in nanoparticle zinc oxide-induced cytotoxicity in vitro
作者: Zhao, JX (Zhao, Jingxia); Yao, Y (Yao, Yang); Liu, SC (Liu, Shichang); Zhang, T (Zhang, Tao); Ren, GG (Ren, Guogang); Yang, Z (Yang, Zhuo)
来源出版物: JOURNAL OF NANOPARTICLE RESEARCH 卷: 14 期: 11 文献号: 1238 DOI: 10.1007/s11051-012-1238-1 出版年: NOV 2012
第 83 条，共 136 条
标题: The Behaviors of Glutathione and Related Amino Acids in the TiO2 Photocatalytic System
作者: Nosaka, AY (Nosaka, Atsuko Y.); Tanaka, G (Tanaka, Goro); Nosaka, Y (Nosaka, Yoshio)
来源出版物: JOURNAL OF PHYSICAL CHEMISTRY B 卷: 116 期: 36 页: 11098-11102 DOI: 10.1021/jp3057338 出版年: SEP 13 2012
第 84 条，共 136 条
标题: Biomedical Effects and Nanosafety of Engineered Nanomaterials: Recent Progress
作者: Wang, XF (Wang Xiaofeng); Zhu, MT (Zhu Motao); Li, JY (Li Jingyuan)
来源出版物: CHINESE JOURNAL OF CHEMISTRY 卷: 30 期: 9 特刊: SI 页:

1931-1947 DOI: 10.1002/cjoc.201200662 出版年: SEP 2012

第 85 条，共 136 条

标题: The progress of silver nanoparticles in the antibacterial mechanism, clinical application and cytotoxicity

作者: You, CG (You, Chuangang); Han, CM (Han, Chunmao); Wang, XG (Wang, Xingang); Zheng, YR (Zheng, Yurong); Li, QY (Li, Qiyin); Hu, XL (Hu, Xinlei); Sun, HF (Sun, Huafeng)

来源出版物: MOLECULAR BIOLOGY REPORTS 卷: 39 期: 9 页: 9193-9201 DOI: 10.1007/s11033-012-1792-8 出版年: SEP 2012

第 86 条，共 136 条

标题: The neurotoxic potential of engineered nanomaterials

作者: Boyes, WK (Boyes, William K.); Chen, R (Chen, Rui); Chen, CY (Chen, Chunying); Yokel, RA (Yokel, Robert A.)

来源出版物: NEUROTOXICOLOGY 卷: 33 期: 4 特刊: SI 页: 902-910 DOI: 10.1016/j.neuro.2011.12.013 出版年: AUG 2012

第 87 条，共 136 条

标题: Therapeutics, imaging and toxicity of nanomaterials in the central nervous system

作者: Nunes, A (Nunes, Antonio); Al-Jamal, KT (Al-Jamal, Khuloud T.); Kostarelos, K (Kostarelos, Kostas)

来源出版物: JOURNAL OF CONTROLLED RELEASE 卷: 161 期: 2 页: 290-306 DOI: 10.1016/j.jconrel.2012.03.026 出版年: JUL 20 2012

第 88 条，共 136 条

标题: Toxico-/biokinetics of nanomaterials

作者: Landsiedel, R (Landsiedel, Robert); Fabian, E (Fabian, Eric); Ma-Hock, L (Ma-Hock, Lan); Wohlleben, W (Wohlleben, Wendel); Wiench, K (Wiench, Karin); Oesch, F (Oesch, Franz); van Ravenzwaay, B (van Ravenzwaay, Ben)

来源出版物: ARCHIVES OF TOXICOLOGY 卷: 86 期: 7 特刊: SI 页: 1021-1060 DOI: 10.1007/s00204-012-0858-7 出版年: JUL 2012

第 89 条，共 136 条

标题: Interference of engineered nanoparticles with in vitro toxicity assays

作者: Kroll, A (Kroll, Alexandra); Pillukat, MH (Pillukat, Mike Hendrik); Hahn, D (Hahn, Daniela); Schnekenburger, J (Schnekenburger, Juergen)

来源出版物: ARCHIVES OF TOXICOLOGY 卷: 86 期: 7 特刊: SI 页: 1123-1136 DOI: 10.1007/s00204-012-0837-z 出版年: JUL 2012

第 90 条，共 136 条

标题: The potential health risk of titania nanoparticles

作者: Zhang, RN (Zhang, Ruinan); Bai, YH (Bai, Yuhong); Zhang, B (Zhang, Bin); Chen, LX (Chen, Lingxin); Yan, B (Yan, Bing)

来源出版物: JOURNAL OF HAZARDOUS MATERIALS 卷: 211 特刊: SI 页: 404-413 DOI: 10.1016/j.jhazmat.2011.11.022 出版年: APR 15 2012

第 91 条，共 136 条

标题: Relation Analysis between Intracellular Distribution of Nanomateriarls, ROS Generation and DNA Damage

作者: Yoshida, T (Yoshida, Tokuyuki); Yoshikawa, T (Yoshikawa, Tomoaki); Nabeshi, H (Nabeshi, Hiromi); Tsutsumi, Y (Tsutsumi, Yasuo)

来源出版物: YAKUGAKU ZASSHI-JOURNAL OF THE PHARMACEUTICAL SOCIETY OF JAPAN 卷: 132 期: 3 页: 295-300 出版年: MAR 2012

第 92 条，共 136 条

标题: Study on biological safety of TiO2 nanomaterials

作者: Luo, XM (Luo, Xiaomin); Wu, DQ (Wu, Dongqiu); Yang, FF (Yang, Feifei)

编者: Chen S; Liu ZT; Zeng QZ

来源出版物: ADVANCES IN CHEMISTRY RESEARCH II, PTS 1-3 丛书: Advanced Materials Research 卷 : 554-556 页 : 1751-1756 DOI: 10.4028/www.scientific.net/AMR.554-556.1751 出版年: 2012

第 93 条，共 136 条

标题: SHORT-TERM EXPOSURE TO NANOPARTICLE-RICH DIESEL ENGINE EXHAUST CAUSES CHANGES IN BRAIN ACTIVITY BUT NOT IN COGNITIVE PERFORMANCE IN HUMAN VOLUNTEERS

作者: Driessen, A (Driessen, Anique); Cruts, B (Cruts, Bjorn); van Etten, L (van Etten, Ludo); Cruts, A (Cruts, Anica); Fokkens, PHB (Fokkens, Paul H. B.); Cassee, FR (Cassee, Flemming R.); Borm, PJA (Borm, Paul J. A.)

编者: Tiddy GJT; Tan RBH

来源出版物: NANOFORMULATION 丛书: Royal Society of Chemistry Special Publications 期: 336 页: 243-255 DOI: 10.1039/9781849735247-00243 出版年: 2012

第 94 条，共 136 条

标题: Toxicological Effects of Titanium Dioxide Nanoparticles: A Review of In Vivo Studies

作者: Iavicoli, I (Iavicoli, Ivo); Leso, V (Leso, Veruscka); Bergamaschi, A (Bergamaschi, Antonio)

来源出版物: JOURNAL OF NANOMATERIALS 文献号: 964381 DOI: 10.1155/2012/964381 出版年: 2012

第 95 条，共 136 条

标题: Nanotech: Propensity in Foods and Bioactives

作者: Kuan, CY (Kuan, Chiu-Yin); Yee-Fung, W (Yee-Fung, Wai); Yuen, KH (Yuen, Kah-Hay); Liong, MT (Liong, Min-Tze)

来源出版物: CRITICAL REVIEWS IN FOOD SCIENCE AND NUTRITION 卷: 52 期: 1-3 页: 55-71 DOI: 10.1080/10408398.2010.494259 出版年: JAN-MAR 2012

第 96 条，共 136 条

标题: In vitro evidence of dysregulation of blood-brain barrier function after acute and repeated/long-term exposure to TiO2 nanoparticles

作者: Brun, E (Brun, Emilie); Carriere, M (Carriere, Marie); Mabondzo, A (Mabondzo, Aloise)

来源出版物: BIOMATERIALS 卷: 33 期: 3 页: 886-896 DOI: 10.1016/j.biomaterials.2011.10.025 出版年: JAN 2012

第 97 条，共 136 条

标题: Effects of Developmental Exposure to TiO2 Nanoparticles on Synaptic Plasticity in Hippocampal Dentate Gyrus Area: an In Vivo Study in Anesthetized Rats

作者: Gao, XY (Gao, Xiaoyan); Yin, ST (Yin, Shuting); Tang, ML (Tang, Mingliang); Chen, JT (Chen, Jutao); Yang, ZF (Yang, Zhongfei); Zhang, WC (Zhang, Wencai); Chen, L (Chen, Liang); Yang, B (Yang, Bo); Li, ZF (Li, Zhifeng); Zha, YY (Zha, Yingying); Ruan, DY (Ruan, Diyun); Wang, M (Wang, Ming)

来源出版物: BIOLOGICAL TRACE ELEMENT RESEARCH 卷: 143 期: 3 页: 1616-1628 DOI: 10.1007/s12011-011-8990-4 出版年: DEC 2011

第 98 条，共 136 条

标题: Titanium dioxide in our everyday life; is it safe?

作者: Skocaj, M (Skocaj, Matej); Filipic, M (Filipic, Metka); Petkovic, J (Petkovic, Jana); Novak, S (Novak, Sasa)

来源出版物: RADIOLOGY AND ONCOLOGY 卷: 45 期: 4 页: 227-247 DOI: 10.2478/v10019-011-0037-0 出版年: DEC 2011

第 99 条，共 136 条

标题: Molecular mechanism of kidney injury of mice caused by exposure to titanium

dioxide nanoparticles

作者: Gui, SX (Gui, Suxing); Zhang, ZL (Zhang, Zengli); Zheng, L (Zheng, Lei); Cui, YL (Cui, Yaling); Liu, XR (Liu, Xiaorun); Li, N (Li, Na); Sang, XZ (Sang, Xuezi); Sun, QQ (Sun, Qingqing); Gao, GD (Gao, Guodong); Cheng, Z (Cheng, Zhe); Cheng, J (Cheng, Jie); Wang, L (Wang, Ling); Tang, M (Tang, Meng); Hong, FS (Hong, Fashui)

来源出版物: JOURNAL OF HAZARDOUS MATERIALS 卷: 195 页: 365-370 DOI: 10.1016/j.jhazmat.2011.08.055 出版年: NOV 15 2011

第 100 条，共 136 条

标题: Toxicity of Nano Gamma Alumina to Neural Stem Cells

作者: Dong, EY (Dong, Erya); Wang, YL (Wang, Yanli); Yang, ST (Yang, Sheng-Tao); Yuan, Y (Yuan, Yuan); Nie, HY (Nie, Haiyu); Chang, YL (Chang, Yanli); Wang, L (Wang, Lin); Liu, YF (Liu, Yuanfang); Wang, HF (Wang, Haifang)

来源出版物: JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 卷: 11 期: 9 页: 7848-7856 DOI: 10.1166/jnn.2011.4748 出版年: SEP 2011

第 101 条，共 136 条

标题: Differential toxicity of silver and titanium dioxide nanoparticles on Drosophila melanogaster development, reproductive effort, and viability: Size, coatings and antioxidants matter

作者: Posgai, R (Posgai, Ryan); Cipolla-McCulloch, CB (Cipolla-McCulloch, Caitlin B.); Murphy, KR (Murphy, Kyle R.); Hussain, SM (Hussain, Saber M.); Rowe, JJ (Rowe, John J.); Nielsen, MG (Nielsen, Mark G.)

来源出版物: CHEMOSPHERE 卷: 85 期: 1 页: 34-42 DOI: 10.1016/j.chemosphere.2011.06.040 出版年: SEP 2011

第 102 条，共 136 条

标题: Assessment of cellular toxicity of TiO2 nanoparticles for cardiac tissue engineering applications

作者: Jawad, H (Jawad, Hedeer); Boccaccini, AR (Boccaccini, Aldo R.); Ali, NN (Ali, Nadire N.); Harding, SE (Harding, Sian E.)

来源出版物: NANOTOXICOLOGY 卷: 5 期: 3 页: 372-380 DOI: 10.3109/17435390.2010.516844 出版年: SEP 2011

第 103 条，共 136 条

标题: Comparison of manganese oxide nanoparticles and manganese sulfate with regard to oxidative stress, uptake and apoptosis in alveolar epithelial cells

作者: Frick, R (Frick, Ramon); Muller-Edenborn, B (Mueller-Edenborn, Bjoern); Schlicker, A (Schlicker, Andreas); Rothen-Rutishauser, B (Rothen-Rutishauser, Barbara); Raemy, DO

(Raemy, David O.); Gunther, D (Guenther, Detlef); Hattendorf, B (Hattendorf, Bodo); Stark, W (Stark, Wendelin); Beck-Schimmer, B (Beck-Schimmer, Beatrice)

来源出版物: TOXICOLOGY LETTERS 卷: 205 期: 2 页: 163-172 DOI: 10.1016/j.toxlet.2011.05.1037 出版年: AUG 28 2011

第 104 条，共 136 条

标题: Analysis of currently available data for characterising the risk of engineered nanomaterials to the environment and human health - Lessons learned from four case studies

作者: Aschberger, K (Aschberger, Karin); Micheletti, C (Micheletti, Christian); Sokull-Kluttgen, B (Sokull-Kluettgen, Birgit); Christensen, FM (Christensen, Frans M.)

来源出版物: ENVIRONMENT INTERNATIONAL 卷: 37 期: 6 特刊: SI 页: 1143-1156 DOI: 10.1016/j.envint.2011.02.005 出版年: AUG 2011

第 105 条，共 136 条

标题: Molecular mechanism of hippocampal apoptosis of mice following exposure to titanium dioxide nanoparticles

作者: Hu, RP (Hu, Renping); Zheng, L (Zheng, Lei); Zhang, T (Zhang, Ting); Gao, GD (Gao, Guodong); Cui, YL (Cui, Yaling); Cheng, Z (Cheng, Zhe); Cheng, J (Cheng, Jie); Hong, MM (Hong, Mengmeng); Tang, M (Tang, Meng); Hong, FS (Hong, Fashui)

来源出版物: JOURNAL OF HAZARDOUS MATERIALS 卷: 191 期: 1-3 页: 32-40 DOI: 10.1016/j.jhazmat.2011.04.027 出版年: JUL 15 2011

第 106 条，共 136 条

标题: Nasal instillation of nanoparticle-rich diesel exhaust particles slightly affects emotional behavior and learning capability in rats

作者: Yokota, S (Yokota, Syunji); Takashima, H (Takashima, Hiromasa); Ohta, R (Ohta, Ryo); Saito, Y (Saito, Yoshiaki); Miyahara, T (Miyahara, Takashi); Yoshida, Y (Yoshida, Yuka); Negura, T (Negura, Tsukasa); Senuma, M (Senuma, Mika); Usumi, K (Usumi, Kenji); Hirabayashi, N (Hirabayashi, Naoyuki); Watanabe, T (Watanabe, Takaho); Horiuchi, S (Horiuchi, Shinji); Fujitani, Y (Fujitani, Yuji); Hirano, S (Hirano, Seishiro); Fujimaki, H (Fujimaki, Hidekazu)

来源出版物: JOURNAL OF TOXICOLOGICAL SCIENCES 卷: 36 期: 3 页: 267-276 出版年: JUN 2011

第 107 条，共 136 条

标题: Nano-TiO2-feasibility and challenges for human health risk assessment based on open literature

作者: Christensen, FM (Christensen, Frans M.); Johnston, HJ (Johnston, Helinor J.); Stone,

V (Stone, Vicki); Aitken, RJ (Aitken, Robert J.); Hankin, S (Hankin, Steve); Peters, S (Peters, Sheona); Aschberger, K (Aschberger, Karin)

来源出版物: NANOTOXICOLOGY 卷: 5 期: 2 页: 110-124 DOI: 10.3109/17435390.2010.504899 出版年: JUN 2011

第 108 条，共 136 条

标题: Cellular Toxicity of TiO2 Nanoparticles in Anatase and Rutile Crystal Phase

作者: Jin, C (Jin, Chan); Tang, Y (Tang, Ying); Yang, FG (Yang, F. Guang); Li, XL (Li, X. Lin); Xu, S (Xu, Shan); Fan, XY (Fan, X. Yan); Huang, YY (Huang, Y. Ying); Yang, YJ (Yang, Y. Ji)

来源出版物: BIOLOGICAL TRACE ELEMENT RESEARCH 卷: 141 期: 1-3 页: 3-15 DOI: 10.1007/s12011-010-8707-0 出版年: JUN 2011

第 109 条，共 136 条

标题: Toxicological effects of titanium dioxide nanoparticles: a review of in vitro mammalian studies

作者: Iavicoli, I (Iavicoli, I.); Leso, V (Leso, V.); Fontana, L (Fontana, L.); Bergamaschi, A (Bergamaschi, A.)

来源出版物: EUROPEAN REVIEW FOR MEDICAL AND PHARMACOLOGICAL SCIENCES 卷: 15 期: 5 页: 481-508 出版年: MAY 2011

第 110 条，共 136 条

标题: Dynamic oversight: implementation gaps and challenges

作者: Howard, J (Howard, John)

来源出版物: JOURNAL OF NANOPARTICLE RESEARCH 卷: 13 期: 4 页: 1427-1434 DOI: 10.1007/s11051-011-0225-2 出版年: APR 2011

第 111 条，共 136 条

标题: Metabonomic Studies of Biochemical Changes in the Serum of Rats by Intratracheally Instilled TiO2 Nanoparticles

作者: Tang, M (Tang, Meng); Zhang, T (Zhang, Ting); Xue, YY (Xue, Yuying); Wang, S (Wang, Shu); Huang, MM (Huang, Mingming); Yang, Y (Yang, Yang); Lu, MY (Lu, Minyu); Lei, H (Lei, Hao); Kong, L (Kong, Lu); Wang, YQ (Wang, Yiqing); Pu, YP (Pu, Yuepu)

来源出版物: JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 卷: 11 期: 4 页: 3065-3074 DOI: 10.1166/jnn.2011.3604 出版年: APR 2011

第 112 条，共 136 条

标题: Comparison of the toxicity of silver, gold and platinum nanoparticles in developing zebrafish embryos

作者: Asharani, PV (Asharani, P. V.); Yi, LW (Yi Lianwu); Gong, ZY (Gong, Zhiyuan); Valiyaveettil, S (Valiyaveettil, Suresh)

来源出版物: NANOTOXICOLOGY 卷: 5 期: 1 页: 43-54 DOI: 10.3109/17435390.2010.489207 出版年: MAR 2011

第 113 条，共 136 条

标题: Risks from accidental exposures to engineered nanoparticles and neurological health effects: A critical review

作者: Simko, M (Simko, Myrtill); Mattsson, MO (Mattsson, Mats-Olof)

来源出版物: PARTICLE AND FIBRE TOXICOLOGY 卷: 7 文献号: 42 DOI: 10.1186/1743-8977-7-42 出版年: DEC 21 2010

第 114 条，共 136 条

标题: Involvement of JNK and P53 activation in G2/M cell cycle arrest and apoptosis induced by titanium dioxide nanoparticles in neuron cells

作者: Wu, J (Wu, Jie); Sun, JA (Sun, Jiao); Xue, Y (Xue, Yang)

来源出版物: TOXICOLOGY LETTERS 卷: 199 期: 3 页: 269-276 DOI: 10.1016/j.toxlet2010.09.009 出版年: DEC 15 2010

第 115 条，共 136 条

标题: Neurotoxicological effects and the impairment of spatial recognition memory in mice caused by exposure to TiO2 nanoparticles

作者: Hu, RP (Hu, Renping); Gong, XL (Gong, Xiaolan); Duan, YM (Duan, Yanmei); Li, N (Li, Na); Che, Y (Che, Yi); Cui, YL (Cui, Yaling); Zhou, M (Zhou, Min); Liu, C (Liu, Chao); Wang, H (Wang, Han); Hong, FS (Hong, Fashui)

来源出版物: BIOMATERIALS 卷: 31 期: 31 页: 8043-8050 DOI: 10.1016/j.biomaterials.2010.07.011 出版年: NOV 2010

第 116 条，共 136 条

标题: Nanoparticles Induce Changes of the Electrical Activity of Neuronal Networks on Microelectrode Array Neurochips

作者: Gramowski, A (Gramowski, Alexandra); Flossdorf, J (Flossdorf, Juliane); Bhattacharya, K (Bhattacharya, Kunal); Jonas, L (Jonas, Ludwig); Lantow, M (Lantow, Margareta); Rahman, Q (Rahman, Qamar); Schiffmann, D (Schiffmann, Dietmar); Weiss, DG (Weiss, Dieter G.); Dopp, E (Dopp, Elke)

来源出版物: ENVIRONMENTAL HEALTH PERSPECTIVES 卷: 118 期: 10 页: 1363-1369 DOI: 10.1289/ehp.0901661 出版年: OCT 2010

第 117 条，共 136 条

标题: Are Commercially Available Nanoparticles Safe When Applied to the Skin?
作者: Robertson, TA (Robertson, Thomas A.); Sanchez, WY (Sanchez, Washington Y.); Roberts, MS (Roberts, Michael S.)
来源出版物: JOURNAL OF BIOMEDICAL NANOTECHNOLOGY 卷: 6 期: 5 特刊: SI 页: 452-468 DOI: 10.1166/jbn.2010.1145 出版年: OCT 2010
第 118 条，共 136 条
标题: Prenatal exposure to titanium dioxide nanoparticles increases dopamine levels in the prefrontal cotex and neostriatum of mice
作者: Takahashi, Y (Takahashi, Yuta); Mizuo, K (Mizuo, Keisuke); Shinkai, Y (Shinkai, Yusuke); Oshio, S (Oshio, Shigeru); Takeda, K (Takeda, Ken)
来源出版物: JOURNAL OF TOXICOLOGICAL SCIENCES 卷: 35 期: 5 页: 749-756 出版年: OCT 2010
第 119 条，共 136 条
标题: A review of nanoparticle functionality and toxicity on the central nervous system
作者: Yang, Z (Yang, Z.); Liu, ZW (Liu, Z. W.); Allaker, RP (Allaker, R. P.); Reip, P (Reip, P.); Oxford, J (Oxford, J.); Ahmad, Z (Ahmad, Z.); Ren, G (Ren, G.)
来源出版物: JOURNAL OF THE ROYAL SOCIETY INTERFACE 卷: 7 页: S411-S422 DOI: 10.1098/rsif.2010.0158.focus 增刊: 4 出版年: AUG 6 2010
第 120 条，共 136 条
标题: A critical review of the biological mechanisms underlying the in vivo and in vitro toxicity of carbon nanotubes: The contribution of physico-chemical characteristics
作者: Johnston, HJ (Johnston, Helinor J.); Hutchison, GR (Hutchison, Gary R.); Christensen, FM (Christensen, Frans M.); Peters, S (Peters, Sheona); Hankin, S (Hankin, Steve); Aschberger, K (Aschberger, Karin); Stone, V (Stone, Vicki)
来源出版物: NANOTOXICOLOGY 卷: 4 期: 2 页: 207-246 DOI: 10.3109/17435390903569639 出版年: JUN 2010
第 121 条，共 136 条
标题: Safety Assessment of Nanomaterials Using Toxicokinetics and Toxicoproteome Analysis
作者: Nabeshi, H (Nabeshi, Hiromi); Yoshikawa, T (Yoshikawa, Tomoaki); Imazawa, T (Imazawa, Takayoshi); Tsunoda, S (Tsunoda, Shin-ichi); Tsutsumi, Y (Tsutsumi, Yasuo)
来源出版物: YAKUGAKU ZASSHI-JOURNAL OF THE PHARMACEUTICAL SOCIETY OF JAPAN 卷: 130 期: 4 页: 465-470 出版年: APR 2010
第 122 条，共 136 条

标题: Adsorption and inhibition of butyrylcholinesterase by different engineered nanoparticles
作者: Wang, ZY (Wang, Zhenyu); Zhang, K (Zhang, Kai); Zhao, J (Zhao, Jian); Liu, XY (Liu, Xiaoyun); Xing, BS (Xing, Baoshan)
来源出版物: CHEMOSPHERE 卷: 79 期: 1 页: 86-92 DOI: 10.1016/j.chemosphere.2009.12.051 出版年: MAR 2010
第 123 条，共 136 条
标题: What's new in nanotoxicology? Implications for public health from a brief review of the 2008 literature
作者: Boczkowski, J (Boczkowski, Jorge); Hoet, P (Hoet, Peter)
来源出版物: NANOTOXICOLOGY 卷: 4 期: 1 页: 1-14 DOI: 10.3109/17435390903428844 出版年: MAR 2010
第 124 条，共 136 条
标题: NANOSIZED TITANIUM DIOXIDE ENHANCED INFLAMMATORY RESPONSES IN THE SEPTIC BRAIN OF MOUSE
作者: Shin, JA (Shin, J. A.); Lee, EJ (Lee, E. J.); Seo, SM (Seo, S. M.); Kim, HS (Kim, H. S.); Kang, JL (Kang, J. L.); Park, EM (Park, E. M.)
来源出版物: NEUROSCIENCE 卷: 165 期: 2 页: 445-454 DOI: 10.1016/j.neuroscience.2009.10.057 出版年: JAN 20 2010
第 125 条，共 136 条
标题: Role of oxidative damage in toxicity of particulates
作者: Moller, P (Moller, Peter); Jacobsen, NR (Jacobsen, Nicklas R.); Folkmann, JK (Folkmann, Janne K.); Danielsen, PH (Danielsen, Pernille H.); Mikkelsen, L (Mikkelsen, Lone); Hemmingsen, JG (Hemmingsen, Jette G.); Vesterdal, LK (Vesterdal, Lise K.); Forchhammer, L (Forchhammer, Lykke); Wallin, H (Wallin, Hakan); Loft, S (Loft, Steffen)
来源出版物: FREE RADICAL RESEARCH 卷: 44 期: 1 页: 1-46 DOI: 10.3109/10715760903300691 出版年: JAN 2010
第 126 条，共 136 条
标题: Analytical atomic spectrometry: an active research area in China
作者: Hou, XD (Hou, Xiandeng)
来源出版物: JOURNAL OF ANALYTICAL ATOMIC SPECTROMETRY 卷: 25 期: 4 页: 447-452 DOI: 10.1039/b927292p 出版年: 2010
第 127 条，共 136 条
标题: Toxicological consequences of TiO2, SiC nanoparticles and multi-walled carbon

nanotubes exposure in several mammalian cell types: an in vitro study
作者: Barillet, S (Barillet, Sabrina); Simon-Deckers, A (Simon-Deckers, Angelique); Herlin-Boime, N (Herlin-Boime, Nathalie); Mayne-L'Hermite, M (Mayne-L'Hermite, Martine); Reynaud, C (Reynaud, Cecile); Cassio, D (Cassio, Doris); Gouget, B (Gouget, Barbara); Carriere, M (Carriere, Marie)
来源出版物: JOURNAL OF NANOPARTICLE RESEARCH 卷: 12 期: 1 特刊: SI 页: 61-73 DOI: 10.1007/s11051-009-9694-y 出版年: JAN 2010
第 128 条，共 136 条
标题: Identification of the mechanisms that drive the toxicity of TiO2 particulates: the contribution of physicochemical characteristics
作者: Johnston, HJ (Johnston, Helinor J.); Hutchison, GR (Hutchison, Gary R.); Christensen, FM (Christensen, Frans M.); Peters, S (Peters, Sheona); Hankin, S (Hankin, Steve); Stone, V (Stone, Vicki)
来源出版物: PARTICLE AND FIBRE TOXICOLOGY 卷: 6 文献号: 33 DOI: 10.1186/1743-8977-6-33 出版年: DEC 17 2009
第 129 条，共 136 条
标题: The Acute Liver Injury in Mice Caused by Nano-Anatase TiO2
作者: Ma, LL (Ma, Linglan); Zhao, JF (Zhao, Jinfang); Wang, J (Wang, Jue); Liu, J (Liu, Jie); Duan, YM (Duan, Yanmei); Liu, HT (Liu, Huiting); Li, N (Li, Na); Yan, JY (Yan, Jingying); Ruan, J (Ruan, Jie); Wang, H (Wang, Han); Hong, FS (Hong, Fashui)
来源出版物: NANOSCALE RESEARCH LETTERS 卷: 4 期: 11 页: 1275-1285 DOI: 10.1007/s11671-009-9393-8 出版年: NOV 2009
第 130 条，共 136 条
标题: Apoptosis induced by titanium dioxide nanoparticles in cultured murine microglia N9 cells
作者: Li, XB (Li XiaoBo); Xu, SQ (Xu ShunQing); Zhang, ZR (Zhang ZhiRen); Schluesener, HJ (Schluesener, Hermann J.)
来源出版物: CHINESE SCIENCE BULLETIN 卷: 54 期: 20 页: 3830-3836 DOI: 10.1007/s11434-009-0548-x 出版年: OCT 2009
第 131 条，共 136 条
标题: National nanotechnology partnership to protect workers
作者: Howard, J (Howard, John); Murashov, V (Murashov, Vladimir)
来源出版物: JOURNAL OF NANOPARTICLE RESEARCH 卷: 11 期: 7 页: 1673-1683 DOI: 10.1007/s11051-009-9682-2 出版年: OCT 2009
第 132 条，共 136 条

标题: Exposure to Titanium Dioxide Nanomaterials Provokes Inflammation of an in Vitro Human Immune Construct

作者: Schanen, BC (Schanen, Brian C.); Karakoti, AS (Karakoti, Ajay S.); Seal, S (Seal, Sudipta); Drake, DR (Drake, Donald R., III); Warren, WL (Warren, William L.); Self, WT (Self, William T.)

来源出版物: ACS NANO 卷: 3 期: 9 页: 2523-2532 DOI: 10.1021/nn900403h 出版年: SEP 2009

第 133 条，共 136 条

标题: Photocatalytic construction and building materials: From fundamentals to applications

作者: Chen, J (Chen, Jun); Poon, CS (Poon, Chi-sun)

来源出版物: BUILDING AND ENVIRONMENT 卷: 44 期: 9 页: 1899-1906 DOI: 10.1016/j.buildenv.2009.01.002 出版年: SEP 2009

第 134 条，共 136 条

标题: Air pollution: mechanisms of neuroinflammation and CNS disease

作者: Block, ML (Block, Michelle L.); Calderon-Garciduenas, L (Calderon-Garciduenas, Lilian)

来源出版物: TRENDS IN NEUROSCIENCES 卷: 32 期: 9 页: 506-516 DOI: 10.1016/j.tins.2009.05.009 出版年: SEP 2009

第 135 条，共 136 条

标题: Nanoparticles and the Brain: Cause for Concern?

作者: Oberdorster, G (Oberdoerster, Guenter); Elder, A (Elder, Alison); Rinderknecht, A (Rinderknecht, Amber)

来源出版物: JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 卷: 9 期: 8 页: 4996-5007 DOI: 10.1166/jnn.2009.GR02 出版年: AUG 2009

第 136 条，共 136 条

标题: The release of TiO2 and SiO2 nanoparticles from nanocomposites

作者: Reijnders, L (Reijnders, L.)

来源出版物: POLYMER DEGRADATION AND STABILITY 卷: 94 期: 5 页: 873-876 DOI: 10.1016/j.polymdegradstab.2009.02.005 出版年: MAY 2009

第 10 条，共 12 条

标题: Time-dependent translocation and potential impairment on central nervous system by intranasally instilled TiO2 nanoparticles

作者: Wang, JX (Wang, Jiangxue); Liu, Y (Liu, Ying); Jiao, F (Jiao, Fang); Lao, F (Lao, Fang); Li, W (Li, Wei); Gu, YQ (Gu, Yiqun); Li, YF (Li, Yufeng); Ge, CC (Ge, Cuicui); Zhou, GQ (Zhou, Guoqiang); Li, B (Li, Bai); Zhao, YL (Zhao, Yuliang); Chai, ZF (Chai, Zhifang); Chen, CY (Chen, Chunying)

来源出版物: TOXICOLOGY 卷: 254 期: 1-2 页: 82-90 DOI: 10.1016/j.tox.2008.09.014 出版年: DEC 5 2008

Web of Science 核心合集中的 "被引频次": 148

第 1 条，共 148 条

标题: In vitro screening of metal oxide nanoparticles for effects on neural function using cortical networks on microelectrode arrays

作者: Strickland, JD (Strickland, Jenna D.); Lefew, WR (Lefew, William R.); Crooks, J (Crooks, James); Hall, D (Hall, Diana); Ortenzio, JNR (Ortenzio, Jayna N. R.); Dreher, K (Dreher, Kevin); Shafer, TJ (Shafer, Timothy J.)

来源出版物: NANOTOXICOLOGY 卷: 10 期: 5 页: 619-628 DOI: 10.3109/17435390.2015.1107142 出版年: MAY 27 2016

第 2 条，共 148 条

标题: The toxicology of ion-shedding zinc oxide nanoparticles

作者: Liu, J (Liu, Jia); Feng, XL (Feng, Xiaoli); Wei, LM (Wei, Limin); Chen, LJ (Chen, Liangjiao); Song, B (Song, Bin); Shao, LQ (Shao, Longquan)

来源出版物: CRITICAL REVIEWS IN TOXICOLOGY 卷: 46 期: 4 页: 348-384 DOI: 10.3109/10408444.2015.1137864 出版年: APR 20 2016

第 3 条，共 148 条

标题: Reproductive and developmental toxicity of carbon-based nanomaterials: A literature review

作者: Ema, M (Ema, Makoto); Hougaard, KS (Hougaard, Karin Sorig); Kishimoto, A (Kishimoto, Atsuo); Honda, K (Honda, Kazumasa)

来源出版物: NANOTOXICOLOGY 卷: 10 期: 4 页: 391-412 DOI: 10.3109/17435390.2015.1073811 出版年: APR 20 2016

第 4 条，共 148 条

标题: Murine liver damage caused by exposure to nano-titanium dioxide

作者: Hong, J (Hong, Jie); Zhang, YQ (Zhang, Yu-Qing)

来源出版物: NANOTECHNOLOGY 卷: 27 期: 11 文献号: 112001 DOI: 10.1088/0957-4484/27/11/112001 出版年: MAR 18 2016

第 5 条，共 148 条

标题: Impact of Carbon Nanomaterials on Actin Polymerization

作者: Dong, Y (Dong, Ying); Sun, HY (Sun, Haiyan); Li, X (Li, Xu); Li, X (Li, Xin); Zhao, LN (Zhao, Lina)

来源出版物: JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 卷: 16 期: 3 页: 2408-2417 DOI: 10.1166/jnn.2016.10659 出版年: MAR 2016

第 6 条，共 148 条

标题: A novel polymeric membrane sensor for determining titanium (III) in real samples: Experimental, molecular and regression modeling

作者: Rezayi, M (Rezayi, Majid); Gholami, M (Gholami, Mehrdad); Said, NR (Said, Nur Rahimah); Alias, Y (Alias, Yatimah)

来源出版物: SENSORS AND ACTUATORS B-CHEMICAL 卷: 224 页: 805-813 DOI: 10.1016/j.snb.2015.10.089 出版年: MAR 1 2016

第 7 条，共 148 条

标题: The effects of exposure to titanium dioxide nanoparticles during lactation period on learning and memory of rat offspring

作者: Mohammadipour, A (Mohammadipour, Abbas); Hosseini, M (Hosseini, Mahmoud); Fazel, A (Fazel, Alireza); Haghir, H (Haghir, Hossein); Rafatpanah, H (Rafatpanah, Houshang); Pourganji, M (Pourganji, Masoume); Bideskan, AE (Bideskan, Alireza Ebrahimzadeh)

来源出版物: TOXICOLOGY AND INDUSTRIAL HEALTH 卷: 32 期: 2 页: 221-228 DOI: 10.1177/0748233713498440 出版年: FEB 2016

第 8 条，共 148 条

标题: Nanomedicine and nanotoxicology: the pros and cons for neurodegeneration and brain cancer

作者: Catalan-Figueroa, J (Catalan-Figueroa, Johanna); Palma-Florez, S (Palma-Florez, Sujey); Alvarez, G (Alvarez, Gonzalo); Fritz, HF (Fritz, Hans F.); Jara, MO (Jara, Miguel O.); Morales, JO (Morales, Javier O.)

来源出版物: NANOMEDICINE 卷: 11 期: 2 页: 171-187 DOI: 10.2217/nnm.15.189 出版年: 2016

第 9 条，共 148 条

标题: Biomedical applications of nano-titania in theranostics and photodynamic therapy

作者: Rehman, FU (Rehman, F. U.); Zhao, C (Zhao, C.); Jiang, H (Jiang, H.); Wang, X (Wang, X.)

来源出版物: BIOMATERIALS SCIENCE 卷: 4 期: 1 页: 40-54 DOI: 10.1039/c5bm00332f 出版年: 2016

第 10 条，共 148 条

标题: TiO2 nanoparticles-induced apoptosis of primary cultured Sertoli cells of mice

作者: Hong, FS (Hong, Fashui); Zhao, XY (Zhao, Xiaoyang); Chen, M (Chen, Ming); Zhou, YJ (Zhou, Yingjun); Ze, YG (Ze, Yuguan); Wang, L (Wang, Ling); Wang, YJ (Wang, Yajing); Ge, YS (Ge, Yushuang); Zhang, Q (Zhang, Qi); Ye, LQ (Ye, Lingqun)

来源出版物: JOURNAL OF BIOMEDICAL MATERIALS RESEARCH PART A 卷: 104 期: 1 页: 124-135 DOI: 10.1002/jbm.a.35548 出版年: JAN 2016

第 11 条，共 148 条

标题: Silver nanoparticles disrupt regulation of steroidogenesis in fish ovarian cells

作者: Degger, N (Degger, Natalie); Tse, ACK (Tse, Anna C. K.); Wu, RSS (Wu, Rudolf S. S.)

来源出版物: AQUATIC TOXICOLOGY 卷: 169 页: 143-151 DOI: 10.1016/j.aquatox.2015.10.015 出版年: DEC 2015

第 12 条，共 148 条

标题: Internalization of titanium dioxide nanoparticles by glial cells is given at short times and is mainly mediated by actin reorganization-dependent endocytosis

作者: Huerta-Garcia, E (Huerta-Garcia, Elizabeth); Marquez-Ramirez, SG (Gissela Marquez-Ramirez, Sandra); Ramos-Godinez, MD (del Pilar Ramos-Godinez, Maria); Lopez-Saavedra, A (Lopez-Saavedra, Alejandro); Herrera, LA (Alonso Herrera, Luis); Parra, A (Parra, Alberto); Alfaro-Moreno, E (Alfaro-Moreno, Ernesto); Gomez, EO (Olivia Gomez, Erika); Lopez-Marure, R (Lopez-Marure, Rebeca)

来源出版物: NEUROTOXICOLOGY 卷: 51 页: 27-37 DOI: 10.1016/j.neuro.2015.08.013 出版年: DEC 2015

第 13 条，共 148 条

标题: Nanomaterial translocation-the biokinetics, tissue accumulation, toxicity and fate of materials in secondary organs-a review

作者: Kermanizadeh, A (Kermanizadeh, Ali); Balharry, D (Balharry, Dominique); Wallin, H (Wallin, Hakan); Loft, S (Loft, Steffen); Moller, P (Moller, Peter)

来源出版物: CRITICAL REVIEWS IN TOXICOLOGY 卷: 45 期: 10 页: 837-872 DOI: 10.3109/10408444.2015.1058747 出版年: NOV 26 2015

第 14 条，共 148 条

标题: Xenobiotic pulmonary exposure and systemic cardiovascular response via neurological links

作者: Stapleton, PA (Stapleton, Phoebe A.); Abukabda, AB (Abukabda, Alaeddin B.); Hardy, SL (Hardy, Steven L.); Nurkiewicz, TR (Nurkiewicz, Timothy R.)

来源出版物: AMERICAN JOURNAL OF PHYSIOLOGY-HEART AND CIRCULATORY PHYSIOLOGY 卷 : 309 期 : 10 页 : H1609-H1620 DOI: 10.1152/ajpheart.00546.2015 出版年: NOV 15 2015

第 15 条，共 148 条

标题: Glucose availability determines silver nanoparticles toxicity in HepG2

作者: Zuberek, M (Zuberek, Mariusz); Wojciechowska, D (Wojciechowska, Dominika); Krzyzanowski, D (Krzyzanowski, Damian); Meczynska-Wielgosz, S (Meczynska-Wielgosz, Sylwia); Kruszewski, M (Kruszewski, Marcin); Grzelak, A (Grzelak, Agnieszka)

来源出版物: JOURNAL OF NANOBIOTECHNOLOGY 卷: 13 文献号: 72 DOI: 10.1186/s12951-015-0132-2 出版年: OCT 22 2015

第 16 条，共 148 条

标题: Hazard effects of nanoparticles in central nervous system: Searching for biocompatible nanomaterials for drug delivery

作者: Leite, PEC (Correa Leite, Paulo Emilio); Pereira, MR (Pereira, Mariana Rodrigues); Granjeiro, JM (Granjeiro, Jose Mauro)

来源出版物: TOXICOLOGY IN VITRO 卷: 29 期: 7 页: 1653-1660 DOI: 10.1016/j.tiv.2015.06.023 出版年: OCT 2015

第 17 条，共 148 条

标题: A review on potential neurotoxicity of titanium dioxide nanoparticles

作者: Song, B (Song, Bin); Liu, J (Liu, Jia); Feng, XL (Feng, Xiaoli); Wei, M (Wei, Limin); Shao, LQ (Shao, Longquan)

来源出版物: NANOSCALE RESEARCH LETTERS 卷: 10 文献号: 342 DOI: 10.1186/s11671-015-1042-9 出版年: AUG 26 2015

第 18 条，共 148 条

标题: Nose-to-Brain Delivery: Investigation of the Transport of Nanoparticles with Different Surface Characteristics and Sizes in Excised Porcine Olfactory Epithelium

作者: Mistry, A (Mistry, Alpesh); Stolnik, S (Stolnik, Snjezana); Illum, L (Illum, Lisbeth)

来源出版物: MOLECULAR PHARMACEUTICS 卷: 12 期: 8 特刊: SI 页: 2755-2766 DOI: 10.1021/acs.molpharmaceut.5b00088 出版年: AUG 2015

第 19 条，共 148 条

标题: Olfactory deposition of inhaled nanoparticles in humans

作者: Garcia, GJM (Garcia, Guilherme J. M.); Schroeter, JD (Schroeter, Jeffry D.); Kimbell, JS (Kimbell, Julia S.)

来源出版物: INHALATION TOXICOLOGY 卷: 27 期: 8 页: 394-403 DOI:

10.3109/08958378.2015.1066904 出版年: JUL 2015

第 20 条，共 148 条

标题: Subacute toxicity of titanium dioxide (TiO2) nanoparticles in male rats: emotional behavior and pathophysiological examination

作者: Ben Younes, NR (Ben Younes, Naima Rihane); Amara, S (Amara, Salem); Mrad, I (Mrad, Imen); Ben-Slama, I (Ben-Slama, Imen); Jeljeli, M (Jeljeli, Mustapha); Omri, K (Omri, Karim); El Ghoul, J (El Ghoul, Jaber); El Mir, L (El Mir, Lassaad); Ben Rhouma, K (Ben Rhouma, Khemais); Abdelmelek, H (Abdelmelek, Hafedh); Sakly, M (Sakly, Mohsen)

来源出版物: ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH 卷: 22 期: 11 页: 8728-8737 DOI: 10.1007/s11356-014-4002-5 出版年: JUN 2015

第 21 条，共 148 条

标题: Suppression of neurite outgrowth of primary cultured hippocampal neurons is involved in impairment of glutamate metabolism and NMDA receptor function caused by nanoparticulate TiO2

作者: Hong, FS (Hong, Fashui); Sheng, L (Sheng, Lei); Ze, YG (Ze, Yuguan); Hong, J (Hong, Jie); Zhou, YJ (Zhou, Yingjun); Wang, L (Wang, Ling); Liu, D (Liu, Dong); Yu, XH (Yu, Xiaohong); Xu, BQ (Xu, Bingqing); Zhao, XY (Zhao, Xiaoyang); Ze, X (Ze, Xiao)

来源出版物: BIOMATERIALS 卷: 53 页: 76-85 DOI: 10.1016/j.biomaterials.2015.02.067 出版年: JUN 2015

第 22 条，共 148 条

标题: Comparative cellular toxicity of titanium dioxide nanoparticles on human astrocyte and neuronal cells after acute and prolonged exposure

作者: Coccini, T (Coccini, Teresa); Grandi, S (Grandi, Stefania); Lonati, D (Lonati, Davide); Locatelli, C (Locatelli, Carlo); De Simone, U (De Simone, Uliana)

来源出版物: NEUROTOXICOLOGY 卷: 48 页: 77-89 DOI: 10.1016/j.neuro.2015.03.006 出版年: MAY 2015

第 23 条，共 148 条

标题: Induction of Size-Dependent Breakdown of Blood-Milk Barrier in Lactating Mice by TiO2 Nanoparticles

作者: Zhang, CK (Zhang, Chengke); Zhai, SM (Zhai, Shumei); Wu, L (Wu, Ling); Bai, YH (Bai, Yuhong); Jia, JB (Jia, Jianbo); Zhang, Y (Zhang, Yi); Zhang, B (Zhang, Bin); Yan, B (Yan, Bing)

来源出版物: PLOS ONE 卷: 10 期: 4 文献号: UNSP e0122591 DOI: 10.1371/journal.pone.0122591 出版年: APR 7 2015

第 24 条，共 148 条

标题: Titanium Nanoparticle Inhalation Induces Renal Fibrosis in Mice via an Oxidative Stress Upregulated Transforming Growth Factor-beta Pathway
作者: Huang, KT (Huang, Kuo-Tong); Wu, CT (Wu, Cheng-Tien); Huang, KH (Huang, Kuo-How); Lin, WC (Lin, Wei-Chou); Chen, CM (Chen, Chang-Mu); Guan, SS (Guan, Siao-Syun); Chiang, CK (Chiang, Chih-Kang); Liu, SH (Liu, Shing-Hwa)
来源出版物: CHEMICAL RESEARCH IN TOXICOLOGY 卷: 28 期: 3 特刊: SI 页: 354-364 DOI: 10.1021/tx500287f 出版年: MAR 2015
第 25 条，共 148 条
标题: Nanomaterials and Neurodegeneration
作者: Migliore, L (Migliore, Lucia); Uboldi, C (Uboldi, Chiara); Di Bucchianico, S (Di Bucchianico, Sebastiano); Coppede, F (Coppede, Fabio)
来源出版物: ENVIRONMENTAL AND MOLECULAR MUTAGENESIS 卷: 56 期: 2 页: 149-170 DOI: 10.1002/em.21931 出版年: MAR 2015
第 26 条，共 148 条
标题: Mechanisms of TiO2 nanoparticle-induced neuronal apoptosis in rat primary cultured hippocampal neurons
作者: Sheng, L (Sheng, Lei); Ze, YG (Ze, Yuguan); Wang, L (Wang, Ling); Yu, XH (Yu, Xiaohong); Hong, J (Hong, Jie); Zhao, XY (Zhao, Xiaoyang); Ze, X (Ze, Xiao); Liu, D (Liu, Dong); Xu, BQ (Xu, Bingqing); Zhu, Y (Zhu, Yunting); Long, Y (Long, Yi); Lin, AA (Lin, Anan); Zhang, C (Zhang, Chi); Zhao, Y (Zhao, Yue); Hong, FH (Hong, Fashui)
来源出版物: JOURNAL OF BIOMEDICAL MATERIALS RESEARCH PART A 卷: 103 期: 3 页: 1141-1149 DOI: 10.1002/jbm.a.35263 出版年: MAR 2015
第 27 条，共 148 条
标题: Nanoparticles: A Neurotoxicological Perspective
作者: Pandey, A (Pandey, Anuradha); Malek, V (Malek, Vajir); Prabhakar, V (Prabhakar, Visakh); Kulkarni, YA (Kulkarni, Yogesh Aanat); Gaikwad, AB (Gaikwad, Anil Bhanudas)
来源出版物: CNS & NEUROLOGICAL DISORDERS-DRUG TARGETS 卷: 14 期: 10 页: 1317-1327 DOI: 10.2174/1871527314666150821112411 出版年: 2015
第 28 条，共 148 条
标题: Assessing the axonal translocation of CeO2 and SiO2 nanoparticles in the sciatic nerve fibers of the frog: an ex vivo electrophysiological study
作者: Kastrinaki, G (Kastrinaki, Georgia); Samsouris, C (Samsouris, Christos); Kosmidis, EK (Kosmidis, Efstratios K.); Papaioannou, E (Papaioannou, Eleni); Konstandopoulos, AG (Konstandopoulos, Athanasios G.); Theophilidis, G (Theophilidis, George)
来源出版物: INTERNATIONAL JOURNAL OF NANOMEDICINE 卷: 10 页:

7089-7096 DOI: 10.2147/IJN.S93663 出版年: 2015

第 29 条，共 148 条

标题: Physiologically based pharmacokinetic modeling of zinc oxide nanoparticles and zinc nitrate in mice

作者: Chen, WY (Chen, Wei-Yu); Cheng, YH (Cheng, Yi-Hsien); Hsieh, NH (Hsieh, Nan-Hung); Wu, BC (Wu, Bo-Chun); Chou, WC (Chou, Wei-Chun); Ho, CC (Ho, Chia-Chi); Chen, JK (Chen, Jen-Kun); Liao, CM (Liao, Chung-Min); Lin, P (Lin, Pinpin)

来源出版物: INTERNATIONAL JOURNAL OF NANOMEDICINE 卷: 10 页: 6277-6292 DOI: 10.2147/IJN.S86785 出版年: 2015

第 30 条，共 148 条

标题: Central nervous system toxicity of metallic nanoparticles

作者: Feng, XL (Feng, Xiaoli); Chen, AJ (Chen, Aijie); Zhang, YL (Zhang, Yanli); Wang, JF (Wang, Jianfeng); Shao, LQ (Shao, Longquan); Wei, LM (Wei, Limin)

来源出版物: INTERNATIONAL JOURNAL OF NANOMEDICINE 卷: 10 页: 4321-4340 DOI: 10.2147/IJN.S78308 出版年: 2015

第 31 条，共 148 条

标题: Titanium dioxide nanoparticles alter cellular morphology via disturbing the microtubule dynamics

作者: Mao, ZL (Mao, Zhilei); Xu, B (Xu, Bo); Ji, XL (Ji, Xiaoli); Zhou, K (Zhou, Kun); Zhang, XM (Zhang, Xuemei); Chen, MJ (Chen, Minjian); Han, XM (Han, Xiumei); Tang, QS (Tang, Qiusha); Wang, XR (Wang, Xinru); Xia, YK (Xia, Yankai)

来源出版物: NANOSCALE 卷: 7 期: 18 页: 8466-8475 DOI: 10.1039/c5nr01448d 出版年: 2015

第 32 条，共 148 条

标题: Involvement of neurotrophins and related signaling genes in TiO2 nanoparticle - induced inflammation in the hippocampus of mice

作者: Su, MY (Su, Mingyu); Sheng, L (Sheng, Lei); Zhao, XY (Zhao, Xiaoyang); Wang, L (Wang, Ling); Yu, XH (Yu, Xiaohong); Hong, J (Hong, Jie); Xu, BQ (Xu, Bingqing); Liu, D (Liu, Dong); Jiang, H (Jiang, Hao); Ze, X (Ze, Xiao); Zhu, YT (Zhu, Yunting); Long, Y (Long, Yi); Zhou, JL (Zhou, Junling); Cui, JW (Cui, Jingwen); Li, K (Li, Kai); Ze, YG (Ze, Yuguan); Hong, FS (Hong, Fashui)

来源出版物: TOXICOLOGY RESEARCH 卷: 4 期: 2 页: 344-350 DOI: 10.1039/c4tx00106k 出版年: 2015

第 33 条，共 148 条

标题: Titanium dioxide nanoparticles enhance production of superoxide anion and alter the

antioxidant system in human osteoblast cells
作者: Niska, K (Niska, Karolina); Pyszka, K (Pyszka, Katarzyna); Tukaj, C (Tukaj, Cecylia); Wozniak, M (Wozniak, Michal); Radomski, MW (Radomski, Marek Witold); Inkielewicz-Stepniak, I (Inkielewicz-Stepniak, Iwona)
来源出版物: INTERNATIONAL JOURNAL OF NANOMEDICINE 卷: 10 页: 1095-1107 DOI: 10.2147/IJN.S73557 出版年: 2015
第 34 条，共 148 条
标题: Ozone, Particulate Matter, and Newly Diagnosed Alzheimer's Disease: A Population-Based Cohort Study in Taiwan
作者: Jung, CR (Jung, Chau-Ren); Lin, YT (Lin, Yu-Ting); Hwang, BF (Hwang, Bing-Fang)
来源出版物: JOURNAL OF ALZHEIMERS DISEASE 卷: 44 期: 2 页: 573-584 DOI: 10.3233/JAD-140855 出版年: 2015
第 35 条，共 148 条
标题: Nanosurface chemistry and dose govern the bioaccumulation and toxicity of carbon nanotubes, metal nanomaterials and quantum dots in vivo
作者: Zhao, F (Zhao, Feng); Meng, H (Meng, Huan); Yan, L (Yan, Liang); Wang, B (Wang, Bing); Zhao, YL (Zhao, Yuliang)
来源出版物: SCIENCE BULLETIN 卷: 60 期: 1 页: 3-20 DOI: 10.1007/s11434-014-0700-0 出版年: JAN 2015
第 36 条，共 148 条
标题: Silica nanoparticles mediated neuronal cell death in corpus striatum of rat brain: implication of mitochondrial, endoplasmic reticulum and oxidative stress
作者: Parveen, A (Parveen, Arshiya); Rizvi, SHM (Rizvi, Syed Husain Mustafa); Mahdi, F (Mahdi, Farzana); Tripathi, S (Tripathi, Sandeep); Ahmad, I (Ahmad, Iqbal); Shukla, RK (Shukla, Rajendra K.); Khanna, VK (Khanna, Vinay K.); Singh, R (Singh, Ranjana); Patel, DK (Patel, Devendra K.); Mahdi, AA (Mahdi, Abbas Ali)
来源出版物: JOURNAL OF NANOPARTICLE RESEARCH 卷: 16 期: 11 文献号: 2664 DOI: 10.1007/s11051-014-2664-z 出版年: NOV 2014
第 37 条，共 148 条
标题: Granular biodurable nanomaterials: No convincing evidence for systemic toxicity
作者: Moreno-Horn, M (Moreno-Horn, Marcus); Gebel, T (Gebel, Thomas)
来源出版物: CRITICAL REVIEWS IN TOXICOLOGY 卷: 44 期: 10 页: 849-875 DOI: 10.3109/10408444.2014.938802 出版年: NOV 2014
第 38 条，共 148 条

标题: Toxicity and bio-accumulation of inhaled cerium oxide nanoparticles in CD1 mice
作者: Aalapati, S (Aalapati, Srinivas); Ganapathy, S (Ganapathy, Selvam); Manapuram, S (Manapuram, Saikumar); Anumolu, G (Anumolu, Goparaju); Prakya, BM (Prakya, Balakrishna Murthy)
来源出版物: NANOTOXICOLOGY 卷: 8 期: 7 页: 786-798 DOI: 10.3109/17435390.2013.829877 出版年: NOV 2014
第 39 条，共 148 条

标题: Nasal aerodynamics protects brain and lung from inhaled dust in subterranean diggers, Ellobius talpinus
作者: Moshkin, MP (Moshkin, M. P.); Petrovski, DV (Petrovski, D. V.); Akulov, AE (Akulov, A. E.); Romashchenko, AV (Romashchenko, A. V.); Gerlinskaya, LA (Gerlinskaya, L. A.); Ganimedov, VL (Ganimedov, V. L.); Muchnaya, MI (Muchnaya, M. I.); Sadovsky, AS (Sadovsky, A. S.); Koptyug, IV (Koptyug, I. V.); Savelov, AA (Savelov, A. A.); Troitsky, SY (Troitsky, S. Yu); Moshkn, YM (Moshkn, Y. M.); Bukhtiyarov, VI (Bukhtiyarov, V. I.); Kolchanov, NA (Kolchanov, N. A.); Sagdeev, RZ (Sagdeev, R. Z.); Fomin, VM (Fomin, V. M.)
来源出版物: PROCEEDINGS OF THE ROYAL SOCIETY B-BIOLOGICAL SCIENCES 卷: 281 期: 1792 文献号: 20140919 DOI: 10.1098/rspb.2014.0919 出版年: OCT 7 2014
第 40 条，共 148 条

标题: Visualization of the biochemical markers of atherosclerotic plaque with the use of Raman, IR and AFM
作者: Marzec, KM (Marzec, Katarzyna M.); Wrobel, TP (Wrobel, Tomasz P.); Rygula, A (Rygula, Anna); Maslak, E (Maslak, Edyta); Jasztal, A (Jasztal, Agnieszka); Fedorowicz, A (Fedorowicz, Andrzej); Chlopicki, S (Chlopicki, Stefan); Baranska, M (Baranska, Malgorzata)
来源出版物: JOURNAL OF BIOPHOTONICS 卷: 7 期: 9 特刊: SI 页: 744-756 DOI: 10.1002/jbio.201400014 出版年: SEP 2014
第 41 条，共 148 条

标题: Uptake of silica nanoparticles: Neurotoxicity and Alzheimer-like pathology in human SK-N-SH and mouse neuro2a neuroblastoma cells
作者: Yang, XF (Yang, Xifei); He, CE (He, Chun'e); Li, J (Li, Jie); Chen, HB (Chen, Hongbin); Ma, Q (Ma, Quan); Sui, XJ (Sui, Xiaojing); Tian, SL (Tian, Shengli); Ying, M (Ying, Ming); Zhang, Q (Zhang, Qian); Luo, YG (Luo, Yougen); Zhuang, ZX (Zhuang, Zhixiong); Liu, JJ (Liu, Jianjun)

来源出版物: TOXICOLOGY LETTERS 卷: 229 期: 1 页: 240-249 DOI: 10.1016/j.toxlet.2014.05.009 出版年: AUG 17 2014

第 42 条，共 148 条

标题: Engineered nanoparticles. How brain friendly is this new guest?

作者: Cupaioli, FA (Cupaioli, Francesca A.); Zucca, FA (Zucca, Fabio A.); Boraschi, D (Boraschi, Diana); Zecca, L (Zecca, Luigi)

来源出版物: PROGRESS IN NEUROBIOLOGY 卷: 119 页: 20-38 DOI: 10.1016/j.pneurobio.2014.05.002 出版年: AUG-SEP 2014

第 43 条，共 148 条

标题: Nanoparticles and Pop-off Technique for Electron Microscopy: A Known Technique for a New Purpose

作者: Lehmbecker, A (Lehmbecker, Annika); Rittinghausen, S (Rittinghausen, Susanne); Rohn, K (Rohn, Kerstin); Baumgartner, W (Baumgaertner, Wolfgang); Schaudien, D (Schaudien, Dirk)

来源出版物: TOXICOLOGIC PATHOLOGY 卷: 42 期: 6 页: 1041-1046 DOI: 10.1177/0192623313509906 出版年: AUG 2014

第 44 条，共 148 条

标题: Titanium dioxide nanoparticles induce strong oxidative stress and mitochondrial damage in glial cells

作者: Huerta-Garcia, E (Huerta-Garcia, Elizabeth); Perez-Arizti, JA (Antonio Perez-Arizti, Jose); Marquez-Ramirez, SG (Gissela Marquez-Ramirez, Sandra); Delgado-Buenrostro, NL (Laura Delgado-Buenrostro, Norma); Chirino, YI (Irasema Chirino, Yolanda); Iglesias, GG (Gutierrez Iglesias, Gisela); Lopez-Marure, R (Lopez-Marure, Rebeca)

来源出版物: FREE RADICAL BIOLOGY AND MEDICINE 卷: 73 页: 84-94 DOI: 10.1016/j.freeradbiomed.2014.04.026 出版年: AUG 2014

第 45 条，共 148 条

标题: Photocatalytic technology in architectural context: From science to societal debates

作者: Megahed, NA (Megahed, Naglaa Ali)

来源出版物: INDOOR AND BUILT ENVIRONMENT 卷: 23 期: 4 页: 603-614 DOI: 10.1177/1420326X13481236 出版年: JUL 2014

第 46 条，共 148 条

标题: Effects of Silica and Titanium Oxide Particles on a Human Neural Stem Cell Line: Morphology, Mitochondrial Activity, and Gene Expression of Differentiation Markers

作者: Fujioka, K (Fujioka, Kouki); Hanada, S (Hanada, Sanshiro); Inoue, Y (Inoue, Yuriko);

Sato, K (Sato, Keisuke); Hirakuri, K (Hirakuri, Kenji); Shiraishi, K (Shiraishi, Kouichi); Kanaya, F (Kanaya, Fumihide); Ikeda, K (Ikeda, Keiichi); Usui, R (Usui, Ritsuko); Yamamoto, K (Yamamoto, Kenji); Kim, SU (Kim, Seung U.); Manome, Y (Manome, Yoshinobu)

来源出版物: INTERNATIONAL JOURNAL OF MOLECULAR SCIENCES 卷: 15 期: 7 页: 11742-11759 DOI: 10.3390/ijms150711742 出版年: JUL 2014

第 47 条，共 148 条

标题: Synthesis of antibacterial TiO2/PLGA composite biofilms

作者: Wu, JY (Wu, Jau-Yi); Li, CW (Li, Ching-Wen); Tsai, CH (Tsai, Ching-Hsiu); Chou, CW (Chou, Chih-Wei); Chen, DR (Chen, Dar-Ren); Wang, GJ (Wang, Gou-Jen)

来源出版物: NANOMEDICINE-NANOTECHNOLOGY BIOLOGY AND MEDICINE 卷: 10 期: 5 页: 1097-1107 DOI: 10.1016/j.nano.2014.01.002 出版年: JUL 2014

第 48 条，共 148 条

标题: Effects of sub-acute exposure to TiO2, ZnO and Al2O3 nanoparticles on oxidative stress and histological changes in mouse liver and brain

作者: Shrivastava, R (Shrivastava, Rupal); Raza, S (Raza, Saimah); Yadav, A (Yadav, Abhishek); Kushwaha, P (Kushwaha, Pramod); Flora, SJS (Flora, Swaran J. S.)

来源出版物: DRUG AND CHEMICAL TOXICOLOGY 卷: 37 期: 3 页: 336-347 DOI: 10.3109/01480545.2013.866134 出版年: JUL 2014

第 49 条，共 148 条

标题: Emergent Properties and Toxicological Considerations for Nanohybrid Materials in Aquatic Systems

作者: Saleh, NB (Saleh, Navid B.); Afrooz, ARMN (Afrooz, A. R. M. Nabiul); Bisesi, JH (Bisesi, Joseph H., Jr.); Aich, N (Aich, Nirupam); Plazas-Tuttle, J (Plazas-Tuttle, Jaime); Sabo-Attwood, T (Sabo-Attwood, Tara)

来源出版物: NANOMATERIALS 卷: 4 期: 2 页: 372-407 DOI: 10.3390/nano4020372 出版年: JUN 2014

第 50 条，共 148 条

标题: Uptake of different crystal structures of TiO2 nanoparticles by Caco-2 intestinal cells

作者: Gitrowski, C (Gitrowski, Constantinos); Al-Jubory, AR (Al-Jubory, Aliaa R.); Handy, RD (Handy, Richard D.)

来源出版物: TOXICOLOGY LETTERS 卷: 226 期: 3 页: 264-276 DOI: 10.1016/j.toxlet.2014.02.014 出版年: MAY 2 2014

第 51 条，共 148 条

标题: Aerosol deposition in nasal passages of burrowing and ground rodents when

breathing dust-laden air

作者: Moshkin, MP (Moshkin, M. P.); Petrovski, DV (Petrovski, D. V.); Akulov, AE (Akulov, A. E.); Romaschenko, AV (Romaschenko, A. V.); Gerlinskaya, LA (Gerlinskaya, L. A.); Muchnaya, MI (Muchnaya, M. I.); Ganimedov, VL (Ganimedov, V. L.); Sadovsky, AS (Sadovsky, A. S.); Savelov, AA (Savelov, A. A.); Koptyug, IV (Koptyug, I. V.); Troitsky, SY (Troitsky, S. Yu.); Bukhtiyarov, VI (Bukhtiyarov, V. I.); Kolchanov, NA (Kolchanov, N. A.); Sagdeyev, RZ (Sagdeyev, R. Z.); Fomin, VM (Fomin, V. M.)

来源出版物: ZHURNAL OBSHCHEI BIOLOGII 卷: 75 期: 3 页: 214-225 出版年: MAY-JUN 2014

第 52 条，共 148 条

标题: TiO2 Nanoparticles Induced Hippocampal Neuroinflammation in Mice

作者: Ze, YG (Ze, Yuguan); Sheng, L (Sheng, Lei); Zhao, XY (Zhao, Xiaoyang); Hong, J (Hong, Jie); Ze, X (Ze, Xiao); Yu, XH (Yu, Xiaohong); Pan, XY (Pan, Xiaoyu); Lin, A (Lin, Anan); Zhao, Y (Zhao, Yue); Zhang, C (Zhang, Chi); Zhou, QP (Zhou, Qiuping); Wang, L (Wang, Ling); Hong, FS (Hong, Fashui)

来源出版物: PLOS ONE 卷: 9 期: 3 文献号: e92230 DOI: 10.1371/journal.pone.0092230 出版年: MAR 21 2014

第 53 条，共 148 条

标题: Maternal exposure to titanium dioxide nanoparticles during pregnancy; impaired memory and decreased hippocampal cell proliferation in rat offspring

作者: Mohammadipour, A (Mohammadipour, Abbas); Fazel, A (Fazel, Alireza); Haghir, H (Haghir, Hossein); Motejaded, F (Motejaded, Fatemeh); Rafatpanah, H (Rafatpanah, Houshang); Zabihi, H (Zabihi, Hoda); Hosseini, M (Hosseini, Mahmoud); Bideskan, AE (Bideskan, Alireza Ebrahimzadeh)

来源出版物: ENVIRONMENTAL TOXICOLOGY AND PHARMACOLOGY 卷: 37 期: 2 页: 617-625 DOI: 10.1016/j.etap.2014.01.014 出版年: MAR 2014

第 54 条，共 148 条

标题: Neurotoxicity of nanoscale materials

作者: Karmakar, A (Karmakar, Alokita); Zhang, QL (Zhang, Qinli); Zhang, YB (Zhang, Yongbin)

来源出版物: JOURNAL OF FOOD AND DRUG ANALYSIS 卷: 22 期: 1 特刊: SI 页: 147-160 DOI: 10.1016/j.jfda.2014.01.012 出版年: MAR 2014

第 55 条，共 148 条

标题: Cell- Based in Vitro Blood-Brain Barrier Model Can Rapidly Evaluate Nanoparticles' Brain Permeability in Association with Particle Size and Surface Modification

作者: Hanada, S (Hanada, Sanshiro); Fujioka, K (Fujioka, Kouki); Inoue, Y (Inoue, Yuriko); Kanaya, F (Kanaya, Fumihide); Manome, Y (Manome, Yoshinobu); Yamamoto, K (Yamamoto, Kenji)

来源出版物: INTERNATIONAL JOURNAL OF MOLECULAR SCIENCES 卷: 15 期: 2 页: 1812-1825 DOI: 10.3390/ijms15021812 出版年: FEB 2014

第 56 条，共 148 条

标题: Nano-Evaluris: an inhalation and explosion risk evaluation method for nanoparticle use. Part I: description of the methodology

作者: Bouillard, JX (Bouillard, Jacques X.); Vignes, A (Vignes, Alexis)

来源出版物: JOURNAL OF NANOPARTICLE RESEARCH 卷: 16 期: 2 文献号: 2149 DOI: 10.1007/s11051-013-2149-5 出版年: FEB 1 2014

第 57 条，共 148 条

标题: Neurotoxicity and gene-expressed profile in brain-injured mice caused by exposure to titanium dioxide nanoparticles

作者: Ze, YG (Ze, Yuguan); Hu, RP (Hu, Renping); Wang, XC (Wang, Xiaochun); Sang, XZ (Sang, Xuezi); Ze, X (Ze, Xiao); Li, B (Li, Bi); Su, JJ (Su, Junju); Wang, Y (Wang, Yuan); Guan, N (Guan, Ning); Zhao, XY (Zhao, Xiaoyang); Gui, SX (Gui, Suxin); Zhu, LY (Zhu, Liyuan); Cheng, Z (Cheng, Zhe); Cheng, J (Cheng, Jie); Sheng, L (Sheng, Lei); Sun, QQ (Sun, Qingqing); Wang, L (Wang, Ling); Hong, FS (Hong, Fashui)

来源出版物: JOURNAL OF BIOMEDICAL MATERIALS RESEARCH PART A 卷: 102 期: 2 页: 470-478 DOI: 10.1002/jbm.a.34705 出版年: FEB 2014

第 58 条，共 148 条

标题: Neurotoxic characteristics of spatial recognition damage of the hippocampus in mice following subchronic peroral exposure to TiO2 nanoparticles

作者: Ze, YG (Ze, Yuguan); Sheng, L (Sheng, Lei); Zhao, XY (Zhao, Xiaoyang); Ze, X (Ze, Xiao); Wang, XC (Wang, Xuecen); Zhou, QP (Zhou, Qiuping); Liu, JL (Liu, Jialiang); Yuan, YF (Yuan, Yifei); Gui, SX (Gui, Suxin); Sang, XZ (Sang, Xuezi); Sun, QQ (Sun, Qingqing); Hong, J (Hong, Jie); Yu, XH (Yu, Xiaohong); Wang, L (Wang, Ling); Li, BY (Li, Bingyan); Hong, F (Hong, Fashui)

来源出版物: JOURNAL OF HAZARDOUS MATERIALS 卷: 264 页: 219-229 DOI: 10.1016/j.jhazmat.2013.10.072 出版年: JAN 15 2014

第 59 条，共 148 条

标题: TITANIUM DIOXIDE NANOPARTICLES - BIOLOGICAL EFFECTS

作者: Swidwinska-Gajewska, AM (Swidwinska-Gajewska, Anna Maria); Czerczak, S (Czerczak, Slawomir)

来源出版物：MEDYCYNA PRACY 卷：65 期：5 页：651-663 DOI: 10.13075/mp.5893.00096 出版年: 2014

第 60 条，共 148 条

标题: Evaluation of Leakage From Fume Hoods Using Tracer Gas, Tracer Nanoparticles and Nanopowder Handling Test Methodologies

作者: Dunn, KH (Dunn, Kevin H.); Tsai, CSJ (Tsai, Candace Su-Jung); Woskie, SR (Woskie, Susan R.); Bennett, JS (Bennett, James S.); Garcia, A (Garcia, Alberto); Ellenbecker, MJ (Ellenbecker, Michael J.)

来源出版物: JOURNAL OF OCCUPATIONAL AND ENVIRONMENTAL HYGIENE 卷: 11 期: 10 页: D164-D173 DOI: 10.1080/15459624.2014.933959 出版年: 2014

第 61 条，共 148 条

标题: Perturbation of physiological systems by nanoparticles

作者: Zhang, Y (Zhang, Yi); Bai, YH (Bai, Yuhong); Jia, JB (Jia, Jianbo); Gao, NN (Gao, Ningning); Li, Y (Li, Yang); Zhang, RN (Zhang, Ruinan); Jiang, GB (Jiang, Guibin); Yan, B (Yan, Bing)

来源出版物: CHEMICAL SOCIETY REVIEWS 卷: 43 期: 10 页: 3762-3809 DOI: 10.1039/c3cs60338e 出版年: 2014

第 62 条，共 148 条

标题: Toxicological Properties of Nanomaterials

作者: Zhang, MY (Zhang, Mingyi); Jin, JJ (Jin, Junjiang); Chang, YN (Chang, Ya-Nan); Chang, XL (Chang, Xueling); Xing, GM (Xing, Gengmei)

来源出版物: JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 卷: 14 期: 1 页: 717-729 DOI: 10.1166/jnn.2014.9198 出版年: JAN 2014

第 63 条，共 148 条

标题: Custom Cerium Oxide Nanoparticles Protect against a Free Radical Mediated Autoimmune Degenerative Disease in the Brain

作者: Heckman, KL (Heckman, Karin L.); DeCoteau, W (DeCoteau, William); Estevez, A (Estevez, Ana); Reed, KJ (Reed, Kenneth J.); Costanzo, W (Costanzo, Wendi); Sanford, D (Sanford, David); Leiter, JC (Leiter, James C.); Clauss, J (Clauss, Jennifer); Knapp, K (Knapp, Kylie); Gomez, C (Gomez, Carlos); Mullen, P (Mullen, Patrick); Rathbun, E (Rathbun, Elle); Prime, K (Prime, Kelly); Marini, J (Marini, Jessica); Patchefsky, J (Patchefsky, Jamie); Patchefsky, AS (Patchefsky, Arthur S.); Hailstone, RK (Hailstone, Richard K.); Erlichman, JS (Erlichman, Joseph S.)

来源出版物: ACS NANO 卷: 7 期: 12 页: 10582-10596 DOI: 10.1021/nn403743b 出版年: DEC 2013

第 64 条，共 148 条

标题: Effect of Intracerebroventricular Injection of TiO2 Nanoparticles on Complex Behaviour in the Rat

作者: Kim, EM (Kim, E. -M.); Palmer, P (Palmer, P.); Howard, V (Howard, V.); Elsaesser, A (Elsaesser, A.); Taylor, A (Taylor, A.); Staats, G (Staats, G.); O'Hare, E (O'Hare, E.)

来源出版物: JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 卷: 13 期: 12 页: 8325-8330 DOI: 10.1166/jnn.2013.8217 出版年: DEC 2013

第 65 条，共 148 条

标题: Acute toxicity of zinc oxide nanoparticles to the rat olfactory system after intranasal instillation

作者: Gao, LF (Gao, Lifeng); Yang, ST (Yang, Sheng-Tao); Li, SR (Li, Shaorui); Meng, YG (Meng, Yuguang); Wang, HF (Wang, Haifang); Lei, H (Lei, Hao)

来源出版物: JOURNAL OF APPLIED TOXICOLOGY 卷: 33 期: 10 页: 1079-1088 DOI: 10.1002/jat.2842 出版年: OCT 2013

第 66 条，共 148 条

标题: Intranasal exposure to amorphous nanosilica particles could activate intrinsic coagulation cascade and platelets in mice

作者: Yoshida, T (Yoshida, Tokuyuki); Yoshioka, Y (Yoshioka, Yasuo); Tochigi, S (Tochigi, Saeko); Hirai, T (Hirai, Toshiro); Uji, M (Uji, Miyuki); Ichihashi, K (Ichihashi, Ko-ichi); Nagano, K (Nagano, Kazuya); Abe, Y (Abe, Yasuhiro); Kamada, H (Kamada, Haruhiko); Tsunoda, S (Tsunoda, Shin-ichi); Nabeshi, H (Nabeshi, Hiromi); Higashisaka, K (Higashisaka, Kazuma); Yoshikawa, T (Yoshikawa, Tomoaki); Tsutsumi, Y (Tsutsumi, Yasuo)

来源出版物: PARTICLE AND FIBRE TOXICOLOGY 卷: 10 文献号: UNSP 41 DOI: 10.1186/1743-8977-10-41 出版年: AUG 20 2013

第 67 条，共 148 条

标题: Titanium dioxide nanoparticle-induced testicular damage, spermatogenesis suppression, and gene expression alterations in male mice

作者: Gao, GD (Gao, Guodong); Ze, YG (Ze, Yuguan); Zhao, XY (Zhao, Xiaoyang); Sang, XZ (Sang, Xuezi); Zheng, L (Zheng, Lei); Ze, X (Ze, Xiao); Gui, SX (Gui, Suxin); Sheng, L (Sheng, Lei); Sun, QQ (Sun, Qingqing); Hong, J (Hong, Jie); Yu, XH (Yu, Xiaohong); Wang, L (Wang, Ling); Hong, FS (Hong, Fashui); Zhang, XG (Zhang, Xueguang)

来源出版物: JOURNAL OF HAZARDOUS MATERIALS 卷: 258 页: 133-143 DOI: 10.1016/j.jhazmat.2013.04.046 出版年: AUG 15 2013

第 68 条，共 148 条

标题: Molecular mechanism of titanium dioxide nanoparticles-induced oxidative injury in the brain of mice

作者: Ze, YG (Ze, Yuguan); Zheng, L (Zheng, Lei); Zhao, XY (Zhao, Xiaoyang); Gui, SX (Gui, Suxin); Sang, XZ (Sang, Xuezi); Su, JJ (Su, Junju); Guan, N (Guan, Ning); Zhu, LY (Zhu, Liyuan); Sheng, L (Sheng, Lei); Hu, RP (Hu, Renping); Cheng, J (Cheng, Jie); Cheng, Z (Cheng, Zhe); Sun, QQ (Sun, Qingqing); Wang, L (Wang, Ling); Hong, FS (Hong, Fashui)

来源出版物: CHEMOSPHERE 卷: 92 期: 9 页: 1183-1189 DOI: 10.1016/j.chemosphere.2013.01.094 出版年: AUG 2013

第 69 条，共 148 条

标题: Developmental Neurotoxicity of Engineered Nanomaterials: Identifying Research Needs to Support Human Health Risk Assessment

作者: Powers, CM (Powers, Christina M.); Bale, AS (Bale, Ambuja S.); Kraft, AD (Kraft, Andrew D.); Makris, SL (Makris, Susan L.); Trecki, J (Trecki, Jordan); Cowden, J (Cowden, John); Hotchkiss, A (Hotchkiss, Andrew); Gillespie, PA (Gillespie, Patricia A.)

来源出版物: TOXICOLOGICAL SCIENCES 卷: 134 期: 2 页: 225-242 DOI: 10.1093/toxsci/kft109 出版年: AUG 2013

第 70 条，共 148 条

标题: Metal-based nanoparticle interactions with the nervous system: the challenge of brain entry and the risk of retention in the organism

作者: Yokel, R (Yokel, Robert); Grulke, E (Grulke, Eric); MacPhail, R (MacPhail, Robert)

来源出版物: WILEY INTERDISCIPLINARY REVIEWS-NANOMEDICINE AND NANOBIOTECHNOLOGY 卷: 5 期: 4 页: 346-373 DOI: 10.1002/wnan.1202 出版年: JUL-AUG 2013

第 71 条，共 148 条

标题: Emerging In Vitro Models for Safety Screening of High-Volume Production Nanomaterials under Environmentally Relevant Exposure Conditions

作者: Kathawala, MH (Kathawala, Mustafa Hussain); Xiong, SJ (Xiong, Sijing); Richards, M (Richards, Mark); Ng, KW (Ng, Kee Woei); George, S (George, Saji); Loo, SCJ (Loo, Say Chye Joachim)

来源出版物: SMALL 卷: 9 期: 9-10 特刊: SI 页: 1504-1520 DOI: 10.1002/smll.201201452 出版年: MAY 27 2013

第 72 条，共 148 条

标题: Titanium dioxide nanoparticles: a review of current toxicological data

作者: Shi, HB (Shi, Hongbo); Magaye, R (Magaye, Ruth); Castranova, V (Castranova,

Vincent); Zhao, JS (Zhao, Jinshun)
来源出版物: PARTICLE AND FIBRE TOXICOLOGY 卷: 10 文献号: 15 DOI: 10.1186/1743-8977-10-15 出版年: APR 15 2013
第 73 条，共 148 条
标题: New vision to CuO, ZnO, and TiO2 nanoparticles: their outcome and effects
作者: Chibber, S (Chibber, Sandesh); Ansari, SA (Ansari, Shakeel Ahmed); Satar, R (Satar, Rukhsana)
来源出版物: JOURNAL OF NANOPARTICLE RESEARCH 卷: 15 期: 4 文献号: UNSP 1492 DOI: 10.1007/s11051-013-1492-x 出版年: APR 2013
第 74 条，共 148 条
标题: Assessment of the Contribution of Electron Microscopy to Nanoparticle Characterization Sampled with Two Cascade Impactors
作者: Noel, A (Noel, Alexandra); L'Esperance, G (L'Esperance, Gilles); Cloutier, Y (Cloutier, Yves); Plamondon, P (Plamondon, Philippe); Boucher, J (Boucher, Julie); Philippe, S (Philippe, Suzanne); Dion, C (Dion, Chantal); Truchon, G (Truchon, Ginette); Zayed, J (Zayed, Joseph)
来源出版物: JOURNAL OF OCCUPATIONAL AND ENVIRONMENTAL HYGIENE 卷: 10 期: 3 页: 155-172 DOI: 10.1080/15459624.2012.760391 出版年: MAR 1 2013
第 75 条，共 148 条
标题: Photocatalytic Oxidation for Maintenance of Indoor Environmental Quality
作者: Yu, CWF (Yu, Chuck W. F.); Kim, JT (Kim, Jeong Tai)
来源出版物: INDOOR AND BUILT ENVIRONMENT 卷: 22 期: 1 特刊: SI 页: 39-51 DOI: 10.1177/1420326X12470282 出版年: FEB 2013
第 76 条，共 148 条
标题: Transient increase in IL-1 beta, IL-6 and TNF-alpha gene expression in rat liver exposed to gold nanoparticles
作者: Khan, HA (Khan, H. A.); Abdelhalim, MAK (Abdelhalim, M. A. K.); Alhomida, AS (Alhomida, A. S.); Al Ayed, MS (Al Ayed, M. S.)
来源出版物: GENETICS AND MOLECULAR RESEARCH 卷: 12 期: 4 页: 5851-5857 DOI: 10.4238/2013.November.22.12 出版年: 2013
第 77 条，共 148 条
标题: Synthesis of Antibacterial TiO2/PLGA Composite Biofilms
作者: Wu, JY (Wu, Jau-Yi); Li, CW (Li, Ching-Wen); Tsai, CH (Tsai, Ching-Hsiu); Wang,

GJ (Wang, Gou-Jen)
书籍团体作者: IEEE
来源出版物: 2013 8TH ANNUAL IEEE INTERNATIONAL CONFERENCE ON NANO/MICRO ENGINEERED AND MOLECULAR SYSTEMS (IEEE NEMS 2013)
页: 98-103 出版年: 2013

第 78 条，共 148 条

标题: Neurotoxic potential of iron oxide nanoparticles in the rat brain striatum and hippocampus
作者: Wu, J (Wu, Jie); Ding, TT (Ding, Tingting); Sun, J (Sun, Jiao)
来源出版物: NEUROTOXICOLOGY 卷: 34 页: 243-253 DOI: 10.1016/j.neuro.2012.09.006 出版年: JAN 2013

第 79 条，共 148 条

标题: Tobacco smoke modulates ozone-induced toxicity in rat lungs and central nervous system
作者: Bhoopalan, V (Bhoopalan, Vanitha); Han, SG (Han, Sung Gu); Shah, MM (Shah, Mrudang M.); Thomas, DM (Thomas, David M.); Bhalla, DK (Bhalla, Deepak K.)
来源出版物: INHALATION TOXICOLOGY 卷: 25 期: 1 页: 21-28 DOI: 10.3109/08958378.2012.751143 出版年: JAN 2013

第 80 条，共 148 条

标题: Titanium dioxide nanoparticles inhibit proliferation and induce morphological changes and apoptosis in glial cells
作者: Marquez-Ramirez, SG (Gissela Marquez-Ramirez, Sandra); Delgado-Buenrostro, NL (Laura Delgado-Buenrostro, Norma); Chirino, YI (Irasema Chirino, Yolanda); Iglesias, GG (Gutierrez Iglesias, Gisela); Lopez-Marure, R (Lopez-Marure, Rebeca)
来源出版物: TOXICOLOGY 卷: 302 期: 2-3 页: 146-156 DOI: 10.1016/j.tox.2012.09.005 出版年: DEC 16 2012

第 81 条，共 148 条

标题: The Toxic Effects and Mechanisms of CuO and ZnO Nanoparticles
作者: Chang, YN (Chang, Ya-Nan); Zhang, MY (Zhang, Mingyi); Xia, L (Xia, Lin); Zhang, J (Zhang, Jun); Xing, GM (Xing, Gengmei)
来源出版物: MATERIALS 卷: 5 期: 12 页: 2850-2871 DOI: 10.3390/ma5122850 出版年: DEC 2012

第 82 条，共 148 条

标题: Surface modification of amorphous nanosilica particles suppresses

nanosilica-induced cytotoxicity, ROS generation, and DNA damage in various mammalian cells

作者: Yoshida, T (Yoshida, Tokuyuki); Yoshioka, Y (Yoshioka, Yasuo); Matsuyama, K (Matsuyama, Keigo); Nakazato, Y (Nakazato, Yasutaro); Tochigi, S (Tochigi, Saeko); Hirai, T (Hirai, Toshiro); Kondoh, S (Kondoh, Sayuri); Nagano, K (Nagano, Kazuya); Abe, Y (Abe, Yasuhiro); Kamada, H (Kamada, Haruhiko); Tsunoda, S (Tsunoda, Shin-ichi); Nabeshi, H (Nabeshi, Hiromi); Yoshikawa, T (Yoshikawa, Tomoaki); Tsutsumi, Y (Tsutsumi, Yasuo)

来源出版物: BIOCHEMICAL AND BIOPHYSICAL RESEARCH COMMUNICATIONS 卷: 427 期: 4 页: 748-752 DOI: 10.1016/j.bbrc.2012.09.132 出版年: NOV 2 2012

第 83 条，共 148 条

标题: Biomedical Applications and Adverse Health Effects of Nanomaterials

作者: Shi, YC (Shi, Yanchao); Li, XY (Li, Xiaoyi)

来源出版物: JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 卷: 12 期: 11 页: 8231-8240 DOI: 10.1166/jnn.2012.6631 出版年: NOV 2012

第 84 条，共 148 条

标题: Recent advances in benefits and hazards of engineered nanoparticles

作者: Radad, K (Radad, Khaled); Al-Shraim, M (Al-Shraim, Mubarak); Moldzio, R (Moldzio, Rudolf); Rausch, WD (Rausch, Wolf-Dieter)

来源出版物: ENVIRONMENTAL TOXICOLOGY AND PHARMACOLOGY 卷: 34 期: 3 页: 661-672 DOI: 10.1016/j.etap.2012.07.011 出版年: NOV 2012

第 85 条，共 148 条

标题: Oxidative stress and inflammatory responses of rat following acute inhalation exposure to iron oxide nanoparticles

作者: Srinivas, A (Srinivas, A.); Rao, PJ (Rao, P. Jaganmohan); Selvam, G (Selvam, G.); Goparaju, A (Goparaju, A.); Murthy, PB (Murthy, P. Balakrishna); Reddy, PN (Reddy, P. Neelakanta)

来源出版物: HUMAN & EXPERIMENTAL TOXICOLOGY 卷: 31 期: 11 页: 1113-1131 DOI: 10.1177/0960327112446515 出版年: NOV 2012

第 86 条，共 148 条

标题: Involvement of reactive oxygen species and high-voltage-activated calcium currents in nanoparticle zinc oxide-induced cytotoxicity in vitro

作者: Zhao, JX (Zhao, Jingxia); Yao, Y (Yao, Yang); Liu, SC (Liu, Shichang); Zhang, T (Zhang, Tao); Ren, GG (Ren, Guogang); Yang, Z (Yang, Zhuo)

来源出版物: JOURNAL OF NANOPARTICLE RESEARCH 卷: 14 期: 11 文献号:

1238 DOI: 10.1007/s11051-012-1238-1 出版年: NOV 2012

第 87 条，共 148 条

标题: Biomedical Effects and Nanosafety of Engineered Nanomaterials: Recent Progress

作者: Wang, XF (Wang Xiaofeng); Zhu, MT (Zhu Motao); Li, JY (Li Jingyuan)

来源出版物: CHINESE JOURNAL OF CHEMISTRY 卷: 30 期: 9 特刊: SI 页: 1931-1947 DOI: 10.1002/cjoc.201200662 出版年: SEP 2012

第 88 条，共 148 条

标题: The potential health risk of titania nanoparticles

作者: Zhang, RN (Zhang, Ruinan); Bai, YH (Bai, Yuhong); Zhang, B (Zhang, Bin); Chen, LX (Chen, Lingxin); Yan, B (Yan, Bing)

来源出版物: JOURNAL OF HAZARDOUS MATERIALS 卷: 211 特刊: SI 页: 404-413 DOI: 10.1016/j.jhazmat.2011.11.022 出版年: APR 15 2012

第 89 条，共 148 条

标题: REPRODUCTIVE TOXICITY OF METALS IN MEN

作者: Pizent, A (Pizent, Alica); Tariba, B (Tariba, Blanka); Zivkovic, T (Zivkovic, Tanja)

来源出版物: ARHIV ZA HIGIJENU RADA I TOKSIKOLOGIJU-ARCHIVES OF INDUSTRIAL HYGIENE AND TOXICOLOGY 卷: 63 页: 35-46 DOI: 10.2478/10004-1254-63-2012-2151 增刊: 1 出版年: APR 2012

第 90 条，共 148 条

标题: Evaluating the Toxicity of Selected Types of Nanochemicals

作者: Kumar, V (Kumar, Vineet); Kumari, A (Kumari, Avnesh); Guleria, P (Guleria, Praveen); Yadav, SK (Yadav, Sudesh Kumar)

编者: Whitacre DM

来源出版物: REVIEWS OF ENVIRONMENTAL CONTAMINATION AND TOXICOLOGY, VOL 215 丛书: Reviews of Environmental Contamination and Toxicology 卷: 215 页: 39-121 DOI: 10.1007/978-1-4614-1463-6_2 出版年: 2012

书籍 DOI

: 10.1007/978-1-4614-1463-6

第 91 条，共 148 条

标题: Nanomaterials in the field of design ergonomics: present status

作者: Chowdhury, A (Chowdhury, Anirban); Sanjog, J (Sanjog, J.); Reddy, SM (Reddy, Swathi Matta); Karmakar, S (Karmakar, Sougata)

来源出版物: ERGONOMICS 卷: 55 期: 12 页: 1453-1462 DOI: 10.1080/00140139.2012.720287 出版年: 2012

第 92 条，共 148 条

标题: SHORT-TERM EXPOSURE TO NANOPARTICLE-RICH DIESEL ENGINE EXHAUST CAUSES CHANGES IN BRAIN ACTIVITY BUT NOT IN COGNITIVE PERFORMANCE IN HUMAN VOLUNTEERS

作者: Driessen, A (Driessen, Anique); Cruts, B (Cruts, Bjorn); van Etten, L (van Etten, Ludo); Cruts, A (Cruts, Anica); Fokkens, PHB (Fokkens, Paul H. B.); Cassee, FR (Cassee, Flemming R.); Borm, PJA (Borm, Paul J. A.)

编者: Tiddy GJT; Tan RBH

来源出版物: NANOFORMULATION 丛书: Royal Society of Chemistry Special Publications 期: 336 页: 243-255 DOI: 10.1039/9781849735247-00243 出版年: 2012

第 93 条，共 148 条

标题: Human Biomonitoring of Engineered Nanoparticles: An Appraisal of Critical Issues and Potential Biomarkers

作者: Bergamaschi, E (Bergamaschi, Enrico)

来源出版物: JOURNAL OF NANOMATERIALS 文献号: 564121 DOI: 10.1155/2012/564121 出版年: 2012

第 94 条，共 148 条

标题: Toxicological Effects of Titanium Dioxide Nanoparticles: A Review of In Vivo Studies

作者: Iavicoli, I (Iavicoli, Ivo); Leso, V (Leso, Veruscka); Bergamaschi, A (Bergamaschi, Antonio)

来源出版物: JOURNAL OF NANOMATERIALS 文献号: 964381 DOI: 10.1155/2012/964381 出版年: 2012

第 95 条，共 148 条

标题: Nano-TiO2/PEEK bioactive composite as a bone substitute material: in vitro and in vivo studies

作者: Wu, XM (Wu, Xiaomian); Liu, XC (Liu, Xiaochen); Wei, J (Wei, Jie); Ma, J (Ma, Jian); Deng, F (Deng, Feng); Wei, SC (Wei, Shicheng)

来源出版物: INTERNATIONAL JOURNAL OF NANOMEDICINE 卷: 7 页: 1215-1225 DOI: 10.2147/IJN.S28101 出版年: 2012

第 96 条，共 148 条

标题: Increased brain radioactivity by intranasal P-32-labeled siRNA dendriplexes within in situ-forming mucoadhesive gels

作者: Perez, AP (Paula Perez, Ana); Mundina-Weilenmann, C (Mundina-Weilenmann,

Cecilia); Romero, EL (Lilia Romero, Eder); Morilla, MJ (Jose Morilla, Maria)
来源出版物: INTERNATIONAL JOURNAL OF NANOMEDICINE 卷: 7 页: 1373-1385 DOI: 10.2147/IJN.S28261 出版年: 2012
第 97 条，共 148 条
标题: In vitro evidence of dysregulation of blood-brain barrier function after acute and repeated/long-term exposure to TiO2 nanoparticles
作者: Brun, E (Brun, Emilie); Carriere, M (Carriere, Marie); Mabondzo, A (Mabondzo, Aloise)
来源出版物: BIOMATERIALS 卷: 33 期: 3 页: 886-896 DOI: 10.1016/j.biomaterials.2011.10.025 出版年: JAN 2012
第 98 条，共 148 条
标题: Effects of Developmental Exposure to TiO2 Nanoparticles on Synaptic Plasticity in Hippocampal Dentate Gyrus Area: an In Vivo Study in Anesthetized Rats
作者: Gao, XY (Gao, Xiaoyan); Yin, ST (Yin, Shuting); Tang, ML (Tang, Mingliang); Chen, JT (Chen, Jutao); Yang, ZF (Yang, Zhongfei); Zhang, WC (Zhang, Wencai); Chen, L (Chen, Liang); Yang, B (Yang, Bo); Li, ZF (Li, Zhifeng); Zha, YY (Zha, Yingying); Ruan, DY (Ruan, Diyun); Wang, M (Wang, Ming)
来源出版物: BIOLOGICAL TRACE ELEMENT RESEARCH 卷: 143 期: 3 页: 1616-1628 DOI: 10.1007/s12011-011-8990-4 出版年: DEC 2011
第 99 条，共 148 条
标题: Titanium dioxide in our everyday life; is it safe?
作者: Skocaj, M (Skocaj, Matej); Filipic, M (Filipic, Metka); Petkovic, J (Petkovic, Jana); Novak, S (Novak, Sasa)
来源出版物: RADIOLOGY AND ONCOLOGY 卷: 45 期: 4 页: 227-247 DOI: 10.2478/v10019-011-0037-0 出版年: DEC 2011
第 100 条，共 148 条
标题: Molecular mechanism of kidney injury of mice caused by exposure to titanium dioxide nanoparticles
作者: Gui, SX (Gui, Suxing); Zhang, ZL (Zhang, Zengli); Zheng, L (Zheng, Lei); Cui, YL (Cui, Yaling); Liu, XR (Liu, Xiaorun); Li, N (Li, Na); Sang, XZ (Sang, Xuezi); Sun, QQ (Sun, Qingqing); Gao, GD (Gao, Guodong); Cheng, Z (Cheng, Zhe); Cheng, J (Cheng, Jie); Wang, L (Wang, Ling); Tang, M (Tang, Meng); Hong, FS (Hong, Fashui)
来源出版物: JOURNAL OF HAZARDOUS MATERIALS 卷: 195 页: 365-370 DOI: 10.1016/j.jhazmat.2011.08.055 出版年: NOV 15 2011
第 101 条，共 148 条

标题: Nanotechnology and Nanotoxicology in Retinopathy
作者: Jo, DH (Jo, Dong Hyun); Lee, TG (Lee, Tae Geol); Kim, JH (Kim, Jeong Hun)
来源出版物: INTERNATIONAL JOURNAL OF MOLECULAR SCIENCES 卷: 12 期: 11 页: 8288-8301 DOI: 10.3390/ijms12118288 出版年: NOV 2011
第 102 条，共 148 条
标题: Assessment of cellular toxicity of TiO2 nanoparticles for cardiac tissue engineering applications
作者: Jawad, H (Jawad, Hedeer); Boccaccini, AR (Boccaccini, Aldo R.); Ali, NN (Ali, Nadire N.); Harding, SE (Harding, Sian E.)
来源出版物: NANOTOXICOLOGY 卷: 5 期: 3 页: 372-380 DOI: 10.3109/17435390.2010.516844 出版年: SEP 2011
第 103 条，共 148 条
标题: Acute inhalation toxicity of cerium oxide nanoparticles in rats
作者: Srinivas, A (Srinivas, A.); Rao, PJ (Rao, P. Jaganmohan); Selvam, G (Selvam, G.); Murthy, PB (Murthy, P. Balakrishna); Reddy, PN (Reddy, P. Neelakanta)
来源出版物: TOXICOLOGY LETTERS 卷: 205 期: 2 页: 105-115 DOI: 10.1016/j.toxlet.2011.05.1027 出版年: AUG 28 2011
第 104 条，共 148 条
标题: Diesel Exhaust Activates and Primes Microglia: Air Pollution, Neuroinflammation, and Regulation of Dopaminergic Neurotoxicity
作者: Levesque, S (Levesque, Shannon); Taetzsch, T (Taetzsch, Thomas); Lull, ME (Lull, Melinda E.); Kodavanti, U (Kodavanti, Urmila); Stadler, K (Stadler, Krisztian); Wagner, A (Wagner, Alison); Johnson, JA (Johnson, Jo Anne); Duke, L (Duke, Laura); Kodavanti, P (Kodavanti, Prasada); Surace, MJ (Surace, Michael J.); Block, ML (Block, Michelle L.)
来源出版物: ENVIRONMENTAL HEALTH PERSPECTIVES 卷: 119 期: 8 页: 1149-1155 DOI: 10.1289/ehp.1002986 出版年: AUG 2011
第 105 条，共 148 条
标题: Molecular mechanism of hippocampal apoptosis of mice following exposure to titanium dioxide nanoparticles
作者: Hu, RP (Hu, Renping); Zheng, L (Zheng, Lei); Zhang, T (Zhang, Ting); Gao, GD (Gao, Guodong); Cui, YL (Cui, Yaling); Cheng, Z (Cheng, Zhe); Cheng, J (Cheng, Jie); Hong, MM (Hong, Mengmeng); Tang, M (Tang, Meng); Hong, FS (Hong, Fashui)
来源出版物: JOURNAL OF HAZARDOUS MATERIALS 卷: 191 期: 1-3 页: 32-40 DOI: 10.1016/j.jhazmat.2011.04.027 出版年: JUL 15 2011

第 106 条，共 148 条

标题: Toxicoproteomic identification of TiO2 nanoparticle-induced protein expression changes in mouse brain

作者: Jeon, YM (Jeon, Yu-Mi); Park, SK (Park, Seul-Ki); Lee, MY (Lee, Mi-Young)

来源出版物: ANIMAL CELLS AND SYSTEMS 卷: 15 期: 2 页: 107-114 DOI: 10.1080/19768354.2011.555144 出版年: JUN 2011

第 107 条，共 148 条

标题: Nanotechnology and Health

作者: Fischman, M (Fischman, Michael); Kosnett, M (Kosnett, Michael); Lichty, P (Lichty, Peter); Howard, J (Howard, John)

团体作者: ACOEM Nanoparticle Task Force

来源出版物: JOURNAL OF OCCUPATIONAL AND ENVIRONMENTAL MEDICINE 卷: 53 期: 6 页: 687-689 DOI: 10.1097/JOM.0b013e31820568ef 出版年: JUN 2011

第 108 条，共 148 条

标题: Nasal instillation of nanoparticle-rich diesel exhaust particles slightly affects emotional behavior and learning capability in rats

作者: Yokota, S (Yokota, Syunji); Takashima, H (Takashima, Hiromasa); Ohta, R (Ohta, Ryo); Saito, Y (Saito, Yoshiaki); Miyahara, T (Miyahara, Takashi); Yoshida, Y (Yoshida, Yuka); Negura, T (Negura, Tsukasa); Senuma, M (Senuma, Mika); Usumi, K (Usumi, Kenji); Hirabayashi, N (Hirabayashi, Naoyuki); Watanabe, T (Watanabe, Takaho); Horiuchi, S (Horiuchi, Shinji); Fujitani, Y (Fujitani, Yuji); Hirano, S (Hirano, Seishiro); Fujimaki, H (Fujimaki, Hidekazu)

来源出版物: JOURNAL OF TOXICOLOGICAL SCIENCES 卷: 36 期: 3 页: 267-276 出版年: JUN 2011

第 109 条，共 148 条

标题: Nano-TiO2-feasibility and challenges for human health risk assessment based on open literature

作者: Christensen, FM (Christensen, Frans M.); Johnston, HJ (Johnston, Helinor J.); Stone, V (Stone, Vicki); Aitken, RJ (Aitken, Robert J.); Hankin, S (Hankin, Steve); Peters, S (Peters, Sheona); Aschberger, K (Aschberger, Karin)

来源出版物: NANOTOXICOLOGY 卷: 5 期: 2 页: 110-124 DOI: 10.3109/17435390.2010.504899 出版年: JUN 2011

第 110 条，共 148 条

标题: Nanoparticles and Colloids as Contributing Factors in Neurodegenerative Disease

作者: Bondy, SC (Bondy, Stephen C.)

来源出版物: INTERNATIONAL JOURNAL OF ENVIRONMENTAL RESEARCH AND PUBLIC HEALTH 卷: 8 期: 6 页: 2200-2211 DOI: 10.3390/ijerph8062200 出版年: JUN 2011

第 111 条，共 148 条

标题: Porous Silicon Nanoparticle Photosensitizers for Singlet Oxygen and Their Phototoxicity against Cancer Cells

作者: Xiao, L (Xiao, Ling); Gu, L (Gu, Luo); Howell, SB (Howell, Stephen B.); Sailor, MJ (Sailor, Michael J.)

来源出版物: ACS NANO 卷: 5 期: 5 页: 3651-3659 DOI: 10.1021/nn1035262 出版年: MAY 2011

第 112 条，共 148 条

标题: Manganese Accumulation in the Olfactory Bulbs and Other Brain Regions of "Asymptomatic" Welders

作者: Sen, S (Sen, Suman); Flynn, MR (Flynn, Michael R.); Du, GW (Du, Guangwei); Troster, AI (Troester, Alexander I.); An, HY (An, Hongyu); Huang, XM (Huang, Xuemei)

来源出版物: TOXICOLOGICAL SCIENCES 卷: 121 期: 1 页: 160-167 DOI: 10.1093/toxsci/kfr033 出版年: MAY 2011

第 113 条，共 148 条

标题: Titania on the brain

作者: [Anonymous] ([Anonymous])

来源出版物: NANOMEDICINE 卷: 6 期: 3 页: 420-420 出版年: APR 2011

第 114 条，共 148 条

标题: Metabonomic Studies of Biochemical Changes in the Serum of Rats by Intratracheally Instilled TiO2 Nanoparticles

作者: Tang, M (Tang, Meng); Zhang, T (Zhang, Ting); Xue, YY (Xue, Yuying); Wang, S (Wang, Shu); Huang, MM (Huang, Mingming); Yang, Y (Yang, Yang); Lu, MY (Lu, Minyu); Lei, H (Lei, Hao); Kong, L (Kong, Lu); Wang, YQ (Wang, Yiqing); Pu, YP (Pu, Yuepu)

来源出版物: JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 卷: 11 期: 4 页: 3065-3074 DOI: 10.1166/jnn.2011.3604 出版年: APR 2011

第 115 条，共 148 条

标题: Nervous system effects in rats on subacute exposure by lead-containing nanoparticles via the airways

作者: Oszlanczi, G (Oszlanczi, Gabor); Papp, A (Papp, Andras); Szabo, A (Szabo, Andrea);

Nagymajtenyi, L (Nagymajtenyi, Laszlo); Sapi, A (Sapi, Andras); Konya, Z (Konya, Zoltan); Paulik, E (Paulik, Edit); Vezer, T (Vezer, Tuende)
来源出版物: INHALATION TOXICOLOGY 卷: 23 期: 4 页: 173-181 DOI: 10.3109/08958378.2011.553248 出版年: MAR 2011
第 116 条，共 148 条
标题: The New Toxicology of Sophisticated Materials: Nanotoxicology and Beyond
作者: Maynard, AD (Maynard, Andrew D.); Warheit, DB (Warheit, David B.); Philbert, MA (Philbert, Martin A.)
来源出版物: TOXICOLOGICAL SCIENCES 卷: 120 页: S109-S129 DOI: 10.1093/toxsci/kfq372 增刊: 1 出版年: MAR 2011
第 117 条，共 148 条
标题: Health Effects of Nanomaterials on Next Generation
作者: Takeda, K (Takeda, Ken); Shinkai, Y (Shinkai, Yusuke); Suzuki, K (Suzuki, Ken-ichiro); Yanagita, S (Yanagita, Shinya); Umezawa, M (Umezawa, Masakazu); Yokota, S (Yokota, Satoshi); Tanaka, H (Tanaka, Hitoshi); Oshio, S (Oshio, Shigeru); Ihara, T (Ihara, Tomomi); Sugamata, M (Sugamata, Masao)
来源出版物: YAKUGAKU ZASSHI-JOURNAL OF THE PHARMACEUTICAL SOCIETY OF JAPAN 卷: 131 期: 2 页: 229-236 DOI: 10.1248/yakushi.131.229 出版年: FEB 2011
第 118 条，共 148 条
标题: TOXICOLOGY OF NANOMATERIALS USED IN NANOMEDICINE
作者: Zhao, JS (Zhao, Jinshun); Castranova, V (Castranova, Vincent)
来源出版物: JOURNAL OF TOXICOLOGY AND ENVIRONMENTAL HEALTH-PART B-CRITICAL REVIEWS 卷: 14 期: 8 页: 593-632 DOI: 10.1080/10937404.2011.615113 出版年: 2011
第 119 条，共 148 条
标题: Risks from accidental exposures to engineered nanoparticles and neurological health effects: A critical review
作者: Simko, M (Simko, Myrtill); Mattsson, MO (Mattsson, Mats-Olof)
来源出版物: PARTICLE AND FIBRE TOXICOLOGY 卷: 7 文献号: 42 DOI: 10.1186/1743-8977-7-42 出版年: DEC 21 2010
第 120 条，共 148 条
标题: Involvement of JNK and P53 activation in G2/M cell cycle arrest and apoptosis induced by titanium dioxide nanoparticles in neuron cells

作者: Wu, J (Wu, Jie); Sun, JA (Sun, Jiao); Xue, Y (Xue, Yang)
来源出版物: TOXICOLOGY LETTERS 卷: 199 期: 3 页: 269-276 DOI: 10.1016/j.toxlet2010.09.009 出版年: DEC 15 2010
第 121 条，共 148 条
标题: Biomechanisms of Nanoparticles (Toxicants, Antioxidants and Therapeutics): Electron Transfer and Reactive Oxygen Species
作者: Kovacic, P (Kovacic, Peter); Somanathan, R (Somanathan, Ratnasamy)
来源出版物: JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 卷: 10 期: 12 页: 7919-7930 DOI: 10.1166/jnn.2010.3028 出版年: DEC 2010
第 122 条，共 148 条
标题: Dose Dependent In Vivo Metabolic Characteristics of Titanium Dioxide Nanoparticles
作者: Tang, M (Tang, Meng); Zhang, T (Zhang, Ting); Xue, YY (Xue, Yuying); Wang, S (Wang, Shu); Huang, MM (Huang, Mingming); Yang, Y (Yang, Yang); Lu, MY (Lu, Minyu); Lei, H (Lei, Hao); Kong, L (Kong, Lu); Pu, YP (Pu Yuepu)
来源出版物: JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 卷: 10 期: 12 页: 8575-8583 DOI: 10.1166/jnn.2010.2482 出版年: DEC 2010
第 123 条，共 148 条
标题: Neurotoxicological effects and the impairment of spatial recognition memory in mice caused by exposure to TiO2 nanoparticles
作者: Hu, RP (Hu, Renping); Gong, XL (Gong, Xiaolan); Duan, YM (Duan, Yanmei); Li, N (Li, Na); Che, Y (Che, Yi); Cui, YL (Cui, Yaling); Zhou, M (Zhou, Min); Liu, C (Liu, Chao); Wang, H (Wang, Han); Hong, FS (Hong, Fashui)
来源出版物: BIOMATERIALS 卷: 31 期: 31 页: 8043-8050 DOI: 10.1016/j.biomaterials.2010.07.011 出版年: NOV 2010
第 124 条，共 148 条
标题: Reproductive and developmental toxicity studies of manufactured nanomaterials
作者: Ema, M (Ema, Makoto); Kobayashi, N (Kobayashi, Norihiro); Naya, M (Naya, Masato); Hanai, S (Hanai, Sosuke); Nakanishi, J (Nakanishi, Junko)
来源出版物: REPRODUCTIVE TOXICOLOGY 卷: 30 期: 3 页: 343-352 DOI: 10.1016/j.reprotox.2010.06.002 出版年: NOV 2010
第 125 条，共 148 条
标题: Skin Absorption and Potential Toxicity of Nanoparticulate Nanomaterials
作者: Baroli, B (Baroli, Biancamaria)

来源出版物: JOURNAL OF BIOMEDICAL NANOTECHNOLOGY 卷: 6 期: 5 特刊: SI 页: 485-496 DOI: 10.1166/jbn.2010.1147 出版年: OCT 2010

第 126 条，共 148 条

标题: Prenatal exposure to titanium dioxide nanoparticles increases dopamine levels in the prefrontal cotex and neostriatum of mice

作者: Takahashi, Y (Takahashi, Yuta); Mizuo, K (Mizuo, Keisuke); Shinkai, Y (Shinkai, Yusuke); Oshio, S (Oshio, Shigeru); Takeda, K (Takeda, Ken)

来源出版物: JOURNAL OF TOXICOLOGICAL SCIENCES 卷: 35 期: 5 页: 749-756 出版年: OCT 2010

第 127 条，共 148 条

标题: Acute toxicity study of the interaction between titanium dioxide nanoparticles and lead acetate in mice

作者: Zhang, R (Zhang, Rong); Niu, YJ (Niu, Yujie); Li, YW (Li, Yawei); Zhao, CF (Zhao, Chunfang); Song, B (Song, Bo); Li, Y (Li, Yao); Zhou, YK (Zhou, Yikai)

来源出版物: ENVIRONMENTAL TOXICOLOGY AND PHARMACOLOGY 卷: 30 期: 1 页: 52-60 DOI: 10.1016/j.etap.2010.03.015 出版年: JUL 2010

第 128 条，共 148 条

标题: A Brief Survey of the Potential Health Risks of TiO2 Particles and TiO2-Containing Photocatalytic or Non-Photocatalytic Materials

作者: Pichat, P (Pichat, Pierre)

来源出版物: JOURNAL OF ADVANCED OXIDATION TECHNOLOGIES 卷: 13 期: 3 特刊: SI 页: 238-246 出版年: JUL 2010

第 129 条，共 148 条

标题: Spleen injury and apoptotic pathway in mice caused by titanium dioxide nanoparticules

作者: Li, N (Li, Na); Duan, YM (Duan, Yanmei); Hong, MM (Hong, Mengmeng); Zheng, L (Zheng, Lei); Fei, M (Fei, Min); Zhao, XY (Zhao, Xiaoyang); Wang, J (Wang, Jue); Cui, YL (Cui, Yaling); Liu, HT (Liu, Huiting); Cai, JW (Cai, Jingwei); Gong, SJ (Gong, Songjie); Wang, H (Wang, Han); Hong, FS (Hong, Fashui)

来源出版物: TOXICOLOGY LETTERS 卷: 195 期: 2-3 页: 161-168 DOI: 10.1016/j.toxlet.2010.03.1116 出版年: JUN 2 2010

第 130 条，共 148 条

标题: Risk assessment of engineered nanomaterials and nanotechnologies-A review

作者: Savolainen, K (Savolainen, Kai); Alenius, H (Alenius, Harri); Norppa, H (Norppa,

Hannu); Pylkkanen, L (Pylkkanen, Lea); Tuomi, T (Tuomi, Timo); Kasper, G (Kasper, Gerhard)

来源出版物: TOXICOLOGY 卷: 269 期: 2-3 特刊: SI 页: 92-104 DOI: 10.1016/j.tox.2010.01.013 出版年: MAR 10 2010

第 131 条，共 148 条

标题: Multifunctional Nanocarriers for diagnostics, drug delivery and targeted treatment across blood-brain barrier: perspectives on tracking and neuroimaging

作者: Bhaskar, S (Bhaskar, Sonu); Tian, FR (Tian, Furong); Stoeger, T (Stoeger, Tobias); Kreyling, W (Kreyling, Wolfgang); de la Fuente, JM (de la Fuente, Jesus M.); Grazu, V (Grazu, Valeria); Borm, P (Borm, Paul); Estrada, G (Estrada, Giovani); Ntziachristos, V (Ntziachristos, Vasilis); Razansky, D (Razansky, Daniel)

来源出版物: PARTICLE AND FIBRE TOXICOLOGY 卷: 7 文献号: 3 DOI: 10.1186/1743-8977-7-3 出版年: MAR 3 2010

第 132 条，共 148 条

标题: Adsorption and inhibition of butyrylcholinesterase by different engineered nanoparticles

作者: Wang, ZY (Wang, Zhenyu); Zhang, K (Zhang, Kai); Zhao, J (Zhao, Jian); Liu, XY (Liu, Xiaoyun); Xing, BS (Xing, Baoshan)

来源出版物: CHEMOSPHERE 卷: 79 期: 1 页: 86-92 DOI: 10.1016/j.chemosphere.2009.12.051 出版年: MAR 2010

第 133 条，共 148 条

标题: Titanium dioxide induces different levels of IL-1 beta production dependent on its particle characteristics through caspase-1 activation mediated by reactive oxygen species and cathepsin B

作者: Morishige, T (Morishige, Tomohiro); Yoshioka, Y (Yoshioka, Yasuo); Tanabe, A (Tanabe, Aya); Yao, XL (Yao, Xinglei); Tsunoda, S (Tsunoda, Shin-ichi); Tsutsumi, Y (Tsutsumi, Yasuo); Mukai, Y (Mukai, Yohei); Okada, N (Okada, Naoki); Nakagawa, S (Nakagawa, Shinsaku)

来源出版物: BIOCHEMICAL AND BIOPHYSICAL RESEARCH COMMUNICATIONS 卷: 392 期: 2 页: 160-165 DOI: 10.1016/j.bbrc.2009.12.178 出版年: FEB 5 2010

第 134 条，共 148 条

标题: Exposure, Uptake, Distribution and Toxicity of Nanomaterials in Humans

作者: Holgate, ST (Holgate, Stephen T.)

来源出版物: JOURNAL OF BIOMEDICAL NANOTECHNOLOGY 卷: 6 期: 1 页: 1-19 DOI: 10.1166/jbn.2010.1098 出版年: FEB 2010

第 135 条，共 148 条

标 题 ： NANOSIZED TITANIUM DIOXIDE ENHANCED INFLAMMATORY RESPONSES IN THE SEPTIC BRAIN OF MOUSE

作者: Shin, JA (Shin, J. A.); Lee, EJ (Lee, E. J.); Seo, SM (Seo, S. M.); Kim, HS (Kim, H. S.); Kang, JL (Kang, J. L.); Park, EM (Park, E. M.)

来 源 出 版 物 ： NEUROSCIENCE 卷 ： 165 期 ： 2 页 ： 445-454 DOI: 10.1016/j.neuroscience.2009.10.057 出版年: JAN 20 2010

第 136 条，共 148 条

标题: Oxidative stress in the brain of mice caused by translocated nanoparticulate TiO2 delivered to the abdominal cavity

作者: Ma, LL (Ma, Linglan); Liu, J (Liu, Jie); Li, N (Li, Na); Wang, J (Wang, Jue); Duan, YM (Duan, Yanmei); Yan, JY (Yan, Jinying); Liu, HT (Liu, Huiting); Wang, H (Wang, Han); Hong, FS (Hong, Fashui)

来 源 出 版 物 ： BIOMATERIALS 卷 ： 31 期 ： 1 页 ： 99-105 DOI: 10.1016/j.biomaterials.2009.09.028 出版年: JAN 2010

第 137 条，共 148 条

标题: Role of oxidative damage in toxicity of particulates

作者: Moller, P (Moller, Peter); Jacobsen, NR (Jacobsen, Nicklas R.); Folkmann, JK (Folkmann, Janne K.); Danielsen, PH (Danielsen, Pernille H.); Mikkelsen, L (Mikkelsen, Lone); Hemmingsen, JG (Hemmingsen, Jette G.); Vesterdal, LK (Vesterdal, Lise K.); Forchhammer, L (Forchhammer, Lykke); Wallin, H (Wallin, Hakan); Loft, S (Loft, Steffen)

来源出版物: FREE RADICAL RESEARCH 卷: 44 期: 1 页: 1-46 DOI: 10.3109/10715760903300691 出版年: JAN 2010

第 138 条，共 148 条

标 题 ： Safety assessment for nanotechnology and nanomedicine: concepts of nanotoxicology

作者: Oberdorster, G (Oberdorster, G.)

来源出版物: JOURNAL OF INTERNAL MEDICINE 卷: 267 期: 1 页: 89-105 DOI: 10.1111/j.1365-2796.2009.02187.x 出版年: JAN 2010

第 139 条，共 148 条

标题: Identification of the mechanisms that drive the toxicity of TiO2 particulates: the contribution of physicochemical characteristics

作 者 ： Johnston, HJ (Johnston, Helinor J.); Hutchison, GR (Hutchison, Gary R.); Christensen, FM (Christensen, Frans M.); Peters, S (Peters, Sheona); Hankin, S (Hankin, Steve); Stone, V (Stone, Vicki)

来源出版物: PARTICLE AND FIBRE TOXICOLOGY 卷: 6 文献号: 33 DOI: 10.1186/1743-8977-6-33 出版年: DEC 17 2009

第 140 条，共 148 条

标题: Glia activation induced by peripheral administration of aluminum oxide nanoparticles in rat brains

作者: Li, XB (Li, Xiao-bo); Zheng, H (Zheng, Hao); Zhang, ZR (Zhang, Zhi-ren); Li, M (Li, Miao); Huang, ZY (Huang, Zhi-yong); Schluesener, HJ (Schluesener, Hermann J.); Li, YY (Li, Yuan-yuan); Xu, SQ (Xu, Shun-qing)

来源出版物: NANOMEDICINE-NANOTECHNOLOGY BIOLOGY AND MEDICINE 卷: 5 期: 4 页: 473-479 DOI: 10.1016/j.nano.2009.01.013 出版年: DEC 2009

第 141 条，共 148 条

标题: The Acute Liver Injury in Mice Caused by Nano-Anatase TiO2

作者: Ma, LL (Ma, Linglan); Zhao, JF (Zhao, Jinfang); Wang, J (Wang, Jue); Liu, J (Liu, Jie); Duan, YM (Duan, Yanmei); Liu, HT (Liu, Huiting); Li, N (Li, Na); Yan, JY (Yan, Jingying); Ruan, J (Ruan, Jie); Wang, H (Wang, Han); Hong, FS (Hong, Fashui)

来源出版物: NANOSCALE RESEARCH LETTERS 卷: 4 期: 11 页: 1275-1285 DOI: 10.1007/s11671-009-9393-8 出版年: NOV 2009

第 142 条，共 148 条

标题: Apoptosis induced by titanium dioxide nanoparticles in cultured murine microglia N9 cells

作者: Li, XB (Li XiaoBo); Xu, SQ (Xu ShunQing); Zhang, ZR (Zhang ZhiRen); Schluesener, HJ (Schluesener, Hermann J.)

来源出版物: CHINESE SCIENCE BULLETIN 卷: 54 期: 20 页: 3830-3836 DOI: 10.1007/s11434-009-0548-x 出版年: OCT 2009

第 143 条，共 148 条

标题: Nanoparticles for direct nose-to-brain delivery of drugs

作者: Mistry, A (Mistry, Alpesh); Stolnik, S (Stolnik, Snjezana); Illum, L (Illum, Lisbeth)

来源出版物: INTERNATIONAL JOURNAL OF PHARMACEUTICS 卷: 379 期: 1 页: 146-157 DOI: 10.1016/j.ijpharm.2009.06.019 出版年: SEP 8 2009

第 144 条，共 148 条

标题: Air pollution: mechanisms of neuroinflammation and CNS disease

作者: Block, ML (Block, Michelle L.); Calderon-Garciduenas, L (Calderon-Garciduenas, Lilian)

来源出版物: TRENDS IN NEUROSCIENCES 卷: 32 期: 9 页: 506-516 DOI:

10.1016/j.tins.2009.05.009 出版年: SEP 2009

第 145 条，共 148 条

标题: Nanoparticles and the Brain: Cause for Concern?

作者: Oberdorster, G (Oberdoerster, Guenter); Elder, A (Elder, Alison); Rinderknecht, A (Rinderknecht, Amber)

来源出版物: JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 卷: 9 期: 8 页: 4996-5007 DOI: 10.1166/jnn.2009.GR02 出版年: AUG 2009

第 146 条，共 148 条

标题: The release of TiO2 and SiO2 nanoparticles from nanocomposites

作者: Reijnders, L (Reijnders, L.)

来源出版物: POLYMER DEGRADATION AND STABILITY 卷: 94 期: 5 页: 873-876 DOI: 10.1016/j.polymdegradstab.2009.02.005 出版年: MAY 2009

第 147 条，共 148 条

标题: Risk of Nanoparticles?

作者: Aust, W (Aust, W.); Daum, N (Daum, N.); Bloching, M (Bloching, M.); Armbruster, V (Armbruester, V.); Jung, E (Jung, E.); Sprau, C (Sprau, C.); Muller, M (Mueller, M.); Boehm, A (Boehm, A.); Mozet, C (Mozet, C.); Wichmann, G (Wichmann, G.); Dietz, A (Dietz, A.)

来源出版物: LARYNGO-RHINO-OTOLOGIE 卷: 88 期: 3 页: 162-166 DOI: 10.1055/s-0029-1192011 出版年: MAR 2009

第 148 条，共 148 条

标题: Effect of physicochemical properties on intranasal nanoparticle transit into murine olfactory epithelium

作者: Mistry, A (Mistry, Alpesh); Glud, SZ (Glud, Sys Zoffmann); Kjems, J (Kjems, Jorgen); Randel, J (Randel, Jens); Howard, KA (Howard, Kenneth Alan); Stolnik, S (Stolnik, Snjezana); Illum, L (Illum, Lisbeth)

来源出版物: JOURNAL OF DRUG TARGETING 卷: 17 期: 7 页: 543-552 DOI: 10.1080/10611860903055470 出版年: 2009

第 11 条，共 13 条

标题: BIOLOGICAL EFFECT OF INTRANASALLY INSTILLED TITANIUM DIOXIDE NANOPARTICLES ON FEMALE MICE

作者: Wang, JX (Wang, Jiangxue); Li, YF (Li, Yufeng); Li, W (Li, Wei); Chen, CY (Chen, Chunying); Li, B (Li, Bai); Zhao, YL (Zhao, Yuliang)

来源出版物: NANO 卷: 3 期: 4 页: 279-285 出版年: AUG 2008

Web of Science 核心合集中的 "被引频次": 6

第 1 条，共 6 条

标题: Impact of Carbon Nanomaterials on Actin Polymerization

作者: Dong, Y (Dong, Ying); Sun, HY (Sun, Haiyan); Li, X (Li, Xu); Li, X (Li, Xin); Zhao, LN (Zhao, Lina)

来源出版物: JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 卷: 16 期: 3 页: 2408-2417 DOI: 10.1166/jnn.2016.10659 出版年: MAR 2016

第 2 条，共 6 条

标题: A review on potential neurotoxicity of titanium dioxide nanoparticles

作者: Song, B (Song, Bin); Liu, J (Liu, Jia); Feng, XL (Feng, Xiaoli); Wei, M (Wei, Limin); Shao, LQ (Shao, Longquan)

来源出版物: NANOSCALE RESEARCH LETTERS 卷: 10 文献号: 342 DOI: 10.1186/s11671-015-1042-9 出版年: AUG 26 2015

第 3 条，共 6 条

标题: Biomedical Applications and Adverse Health Effects of Nanomaterials

作者: Shi, YC (Shi, Yanchao); Li, XY (Li, Xiaoyi)

来源出版物: JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 卷: 12 期: 11 页: 8231-8240 DOI: 10.1166/jnn.2012.6631 出版年: NOV 2012

第 4 条，共 6 条

标题: Metabonomic Studies of Biochemical Changes in the Serum of Rats by Intratracheally Instilled TiO2 Nanoparticles

作者: Tang, M (Tang, Meng); Zhang, T (Zhang, Ting); Xue, YY (Xue, Yuying); Wang, S (Wang, Shu); Huang, MM (Huang, Mingming); Yang, Y (Yang, Yang); Lu, MY (Lu, Minyu); Lei, H (Lei, Hao); Kong, L (Kong, Lu); Wang, YQ (Wang, Yiqing); Pu, YP (Pu, Yuepu)

来源出版物: JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 卷: 11 期: 4 页: 3065-3074 DOI: 10.1166/jnn.2011.3604 出版年: APR 2011

第 5 条，共 6 条

标题: The Immune Toxicity of Titanium Dioxide on Primary Pulmonary Alveolar Macrophages Relies on their Surface Area and Crystal Structure

作者: Liu, R (Liu, Ran); Yin, LH (Yin, Li-hong); Pu, YP (Pu, Yue-pu); Li, YH (Li, Yun-hui); Zhang, XQ (Zhang, Xiao-qiang); Liang, GY (Liang, Ge-yu); Li, XB (Li, Xiao-bo); Zhang, JA (Zhang, Juan); Li, YF (Li, Yan-fen); Zhang, XY (Zhang, Xue-yan)

来源出版物: JOURNAL OF NANOSCIENCE AND NANOTECHNOLOGY 卷: 10 期: 12 页: 8491-8499 DOI: 10.1166/jnn.2010.2685 出版年: DEC 2010

第 6 条，共 6 条

标题: RECLAMATION PROBLEMS FOR THE AREA OF A FORMER BOREHOLE SULPHUR MINE WITH PARTICULAR REFERENCE TO SOIL AIR PROPERTIES

作者: Bryk, M (Bryk, M.); Kolodziej, B (Kolodziej, B.)

来源出版物: LAND DEGRADATION & DEVELOPMENT 卷: 20 期: 5 页: 509-521 DOI: 10.1002/ldr.928 出版年: SEP-OCT 2009

第 12 条，共 12 条

标题: Scalp hair as a biomarker in environmental and occupational mercury exposed populations: Suitable or not?

作者: Li, YF (Li, Yu-Feng); Chen, CY (Chen, Chunying); Li, B (Li, Bai); Wang, JX (Wang, Jiangxue); Gao, YX (Gao, Yuxi); Zhao, YL (Zhao, Yuliang); Chai, ZF (Chai, Zhifang)

来源出版物: ENVIRONMENTAL RESEARCH 卷: 107 期: 1 页: 39-44 DOI: 10.1016/j.envres.2007.07.003 出版年: MAY 2008

Web of Science 核心合集中的 "被引频次": 16

第 1 条，共 16 条

标题: Methods for Individualized Determination of Methylmercury Elimination Rate and De-Methylation Status in Humans Following Fish Consumption

作者: Rand, MD (Rand, Mathew D.); Vorojeikina, D (Vorojeikina, Daria); van Wijngaarden, E (van Wijngaarden, Edwin); Jackson, BP (Jackson, Brian P.); Scrimale, T (Scrimale, Thomas); Zareba, G (Zareba, Grazyna); Love, TM (Love, Tanzy M.); Myers, GJ (Myers, Gary J.); Watson, GE (Watson, Gene E.)

来源出版物: TOXICOLOGICAL SCIENCES 卷: 149 期: 2 页: 385-395 DOI: 10.1093/toxsci/kfv241 出版年: FEB 2016

第 2 条，共 16 条

标题: Mercury analysis in hair: Comparability and quality assessment within the transnational COPHES/DEMOCOPHES project

作者: Esteban, M (Esteban, Marta); Schindler, BK (Schindler, Birgit Karin); Jimenez, JA (Jimenez, Jose Antonio); Koch, HM (Koch, Holger Martin); Angerer, J (Angerer, Juergen); Rosado, M (Rosado, Montserrat); Gomez, S (Gomez, Silvia); Casteleyn, L (Casteleyn, Ludwine); Kolossa-Gehring, M (Kolossa-Gehring, Marike); Becker, K (Becker, Kerstin); Bloemen, L (Bloemen, Louis); Schoeters, G (Schoeters, Greet); Den Hond, E (Den Hond,

Elly); Sepai, O (Sepai, Ovnair); Exley, K (Exley, Karen); Horvat, M (Horvat, Milena); Knudsen, LE (Knudsen, Lisbeth E.); Joas, A (Joas, Anke); Joas, R (Joas, Reinhard); Aerts, D (Aerts, Dominique); Biot, P (Biot, Pierre); Borosova, D (Borosova, Daniela); Davidson, F (Davidson, Fred); Dumitrascu, I (Dumitrascu, Irina); Fischer, ME (Fischer, Marc E.); Grander, M (Grander, Margaretha); Janasik, B (Janasik, Beata); Jones, K (Jones, Kate); Kasparova, L (Kasparova, Lucie); Larssen, T (Larssen, Thorjorn); Naray, M (Naray, Miklos); Nielsen, F (Nielsen, Flemming); Hohenblum, P (Hohenblum, Philipp); Pinto, R (Pinto, Rui); Pirard, C (Pirard, Catherine); Plateel, G (Plateel, Gregory); Tratnik, JS (Tratnik, Janja Snoj); Wittsiepe, J (Wittsiepe, Juergen); Castano, A (Castano, Argelia)

团体作者: EQUAS Reference Labs

来源出版物: ENVIRONMENTAL RESEARCH 卷: 141 特刊: SI 页: 24-30 DOI: 10.1016/j.envres.2014.11.014 出版年: AUG 2015

第 3 条，共 16 条

标题: Cardiovascular responses to lead are biphasic, while methylmercury, but not inorganic mercury, monotonically increases blood pressure in rats

作者: Wildemann, TM (Wildemann, Tanja M.); Mirhosseini, N (Mirhosseini, Naghmeh); Siciliano, SD (Siciliano, Steven D.); Weber, LP (Weber, Lynn P.)

来源出版物: TOXICOLOGY 卷: 328 页: 1-11 DOI: 10.1016/j.tox.2014.11.009 出版年: FEB 3 2015

第 4 条，共 16 条

标题: Assessment of mercury exposure among small-scale gold miners using mercury stable isotopes

作者: Sherman, LS (Sherman, Laura S.); Blum, JD (Blum, Joel D.); Basu, N (Basu, Niladri); Rajaee, M (Rajaee, Mozhgon); Evers, DC (Evers, David C.); Buck, DG (Buck, David G.); Petrlik, J (Petrlik, Jindrich); DiGangi, J (DiGangi, Joseph)

来源出版物: ENVIRONMENTAL RESEARCH 卷: 137 页: 226-234 DOI: 10.1016/j.envres.2014.12.021 出版年: FEB 2015

第 5 条，共 16 条

标题: Surveying Mercury Levels in Hair, Blood and Urine of under 7-Year Old Children from a Coastal City in China

作者: Chen, GX (Chen, Guixia); Chen, XX (Chen, Xiaoxin); Yan, CH (Yan, Chonghuai); Wu, XD (Wu, Xingdong); Zeng, GZ (Zeng, Guozhang)

来源出版物: INTERNATIONAL JOURNAL OF ENVIRONMENTAL RESEARCH AND PUBLIC HEALTH 卷: 11 期: 11 页: 12029-12041 DOI: 10.3390/ijerph111112029 出版年: NOV 2014

第 6 条，共 16 条

标题: Hair mercury and urinary cadmium levels in Belgian children and their mothers within the framework of the COPHES/DEMOCOPHES projects

作者: Pirard, C (Pirard, Catherine); Koppen, G (Koppen, Gudrun); De Cremer, K (De Cremer, Koen); Van Overmeire, I (Van Overmeire, Ilse); Govarts, E (Govarts, Eva); Dewolf, MC (Dewolf, Marie-Christine); Van de Mieroop, E (Van de Mieroop, Els); Aerts, D (Aerts, Dominique); Biot, P (Biot, Pierre); Casteleyn, L (Casteleyn, Ludwine); Kolossa-Gehring, M (Kolossa-Gehring, Marike); Schwedler, G (Schwedler, Gerda); Angerer, J (Angerer, Juergen); Koch, HM (Koch, Holger M.); Schindler, BK (Schindler, Birgit K.); Castano, A (Castano, Argelia); Esteban, M (Esteban, Marta); Schoeters, G (Schoeters, Greet); Den Hond, E (Den Hond, Elly); Sepai, O (Sepai, Ovnair); Exley, K (Exley, Karen); Horvat, M (Horvat, Milena); Bloemen, L (Bloemen, Louis); Knudsen, LE (Knudsen, Lisbeth E.); Joas, R (Joas, Reinhard); Joas, A (Joas, Anke); Van Loco, J (Van Loco, Joris); Charlier, C (Charlier, Corinne)

来源出版物: SCIENCE OF THE TOTAL ENVIRONMENT 卷: 472 页: 730-740 DOI: 10.1016/j.scitotenv.2013.11.028 出版年: FEB 15 2014

第 7 条，共 16 条

标题: Physiological and proteomic changes suggest an important role of cell walls in the high tolerance to metals of Elodea nuttallii

作者: Larras, F (Larras, Floriane); Regier, N (Regier, Nicole); Planchon, S (Planchon, Sebastien); Pote, J (Pote, John); Renaut, J (Renaut, Jenny); Cosio, C (Cosio, Claudia)

来源出版物: JOURNAL OF HAZARDOUS MATERIALS 卷: 263 页: 575-583 DOI: 10.1016/j.jhazmat.2013.10.016 子辑: 2 出版年: DEC 15 2013

第 8 条，共 16 条

标题: Prenatal methylmercury exposure through maternal rice ingestion: Insights from a feasibility pilot in Guizhou Province, China

作者: Rothenberg, SE (Rothenberg, Sarah E.); Yu, XD (Yu, Xiaodan); Zhang, YM (Zhang, Yumei)

来源出版物: ENVIRONMENTAL POLLUTION 卷: 180 页: 291-298 DOI: 10.1016/j.envpol.2013.05.037 出版年: SEP 2013

第 9 条，共 16 条

标题: New Insight into Biomarkers of Human Mercury Exposure Using Naturally Occurring Mercury Stable Isotopes

作者: Sherman, LS (Sherman, Laura S.); Blum, JD (Blum, Joel D.); Franzblau, A (Franzblau, Alfred); Basu, N (Basu, Niladri)

来源出版物: ENVIRONMENTAL SCIENCE & TECHNOLOGY 卷: 47 期: 7 页: 3403-3409 DOI: 10.1021/es305250z 出版年: APR 2 2013

第 10 条，共 16 条

标题: Hg Speciation and Stable Isotope Signatures in Human Hair As a Tracer for Dietary and Occupational Exposure to Mercury

作者: Laffont, L (Laffont, Laure); Sonke, JE (Sonke, Jeroen E.); Maurice, L (Maurice, Laurence); Monrroy, SL (Luna Monrroy, Selma); Chincheros, J (Chincheros, Jaime); Amouroux, D (Amouroux, David); Behra, P (Behra, Philippe)

来源出版物: ENVIRONMENTAL SCIENCE & TECHNOLOGY 卷: 45 期: 23 页: 9910-9916 DOI: 10.1021/es202353m 出版年: DEC 1 2011

第 11 条，共 16 条

标题: Hair can be a good biomarker of occupational exposure to mercury vapor: Simulated experiments and field data analysis

作者: Li, P (Li, Ping); Feng, XB (Feng, Xinbin); Qiu, GL (Qiu, Guangle); Wan, Q (Wan, Qi)

来源出版物: SCIENCE OF THE TOTAL ENVIRONMENT 卷: 409 期: 20 页: 4484-4488 DOI: 10.1016/j.scitotenv.2011.06.045 出版年: SEP 15 2011

第 12 条，共 16 条

标题: Low-level maternal methylmercury exposure through rice ingestion and potential implications for offspring health

作者: Rothenberg, SE (Rothenberg, Sarah E.); Feng, XB (Feng, Xinbin); Li, P (Li, Ping)

来源出版物: ENVIRONMENTAL POLLUTION 卷: 159 期: 4 页: 1017-1022 DOI: 10.1016/j.envpol.2010.12.024 出版年: APR 2011

第 13 条，共 16 条

标题: Human co-exposure to mercury vapor and methylmercury in artisanal mercury mining areas, Guizhou, China

作者: Li, P (Li, Ping); Feng, XB (Feng, Xinbin); Shang, LH (Shang, Lihai); Qiu, GL (Qiu, Guangle); Meng, B (Meng, Bo); Zhang, H (Zhang, Hua); Guo, YN (Guo, Yanna); Liang, P (Liang, Peng)

来源出版物: ECOTOXICOLOGY AND ENVIRONMENTAL SAFETY 卷: 74 期: 3 页: 473-479 DOI: 10.1016/j.ecoenv.2010.10.030 出版年: MAR 2011

第 14 条，共 16 条

标题: Mercury exposure assessment in Iranian women's hair of a port town with respect to fish consumption and amalgam fillings

作者: Fakour, H (Fakour, H.); Esmaili-Sari, A (Esmaili-Sari, A.); Zayeri, F (Zayeri, F.)
来源出版物: SCIENCE OF THE TOTAL ENVIRONMENT 卷: 408 期: 7 页: 1538-1543 DOI: 10.1016/j.scitotenv.2010.01.008 出版年: MAR 1 2010
第 15 条，共 16 条
标题: Mercury Exposure: Effects Across the Lifespan
作者: Taber, KH (Taber, Katherine H.); Hurley, RA (Hurley, Robin A.)
来源出版物: JOURNAL OF NEUROPSYCHIATRY AND CLINICAL NEUROSCIENCES 卷: 20 期: 4 页: IV-389 DOI: 10.1176/appi.neuropsych.20.2.iv 出版年: FAL 2008
第 16 条，共 16 条
标题: Eighth International Conference on Mercury as a Global Pollutant (ICMGP): Human health and exposure to methylmercury - Introduction
作者: Anderson, HA (Anderson, Henry A.)
来源出版物: ENVIRONMENTAL RESEARCH 卷: 107 期: 1 页: 1-3 DOI: 10.1016/j.envres.2008.02.005 出版年: MAY 2008

2016年专业技术职务评聘论文发表及收录情况证明表

单位：

姓名	王江雪	工作证号	08510	现任职称	讲师	任职时间	2007.07

任现职以来发表论文及收录情况：收录类别、作者贡献（第一、通讯等）仅计算1次；论文收录以图书馆检索证明为准，未检索到的来源刊论文仅计算1篇

类别	合计	SCI	SSCI	CSSCI	EI	ISTP	中文核心期刊	其他
一、符合职称申报条件论文	12(+1)	9(+1)			1		2	
其中：1.第一作者	12(+1)	9(+1)			1		2	
2.学生第一本人第二作者								
3.通讯作者								
二、其他	9	4			1		4	

本人承诺以上所填属实，如与事实不符，本人愿承担一切责任。

本人签字：王江雪　　日期：2016年5月25日

单位负责人签字（加盖公章）：[illegible]　　日期：2016年5月25日

图书馆意见：

经检索，上表所列论文发表及收录情况属实。

经检索，上表中被SCIE/EI收录的文章数及SCI、北大核心期刊刊源之刊物种数情况属实。

证明人：[illegible]　　盖章：北京航空航天大学图书馆检索专用章　　日期：2016年5月26日

注：1.申请人认真如实填写相关信息后A4纸单面打印；

2.对于学生第一本人第二作者的论文需填写《2016年专业技术职务评聘研究生指导情况证明表》由所在单位认定，主管副院长签字，学院盖章，研究生院审定，一并去图书馆认定。

北京航空航大学专业技术职务评审
任现职以来主要教学工作业绩水平证明表

姓　　名　王江雪　　单位　生物与医学工程学院
现任专业技术职务　讲师　　任现职时间　2007.07
申请专业技术职务　副教授　　填表日期　2016.05.23

一、教学总体情况

任现职以来，独立指导硕士研究生 5 届 5 人，其中毕业 2 人，在读 3 人；指导本科毕设 3 人，主讲本科生课 3 门，其中必修课 2 门；主讲研究生课＿＿门、其中学位课＿＿门。年均授课 34.89 学时。

二、本科教学工作量

	课程代码	课程名称	学年-学期	课程学时	本人授课学时	授课对象（本科生/留学生等）	授课次数（几轮次）	课程性质
教学工作量	E10D3570	生物统计学	2011-2012-1 2012-2013-1 2013-2014-1 2014-2015-1	32 32 32 32	14 16 16 16	本科生	4	必修课
	F10C3221	生物统计学	2015-2016-2	32	16	本科生	1	必修课
	E10D3560	实验动物学	2011-2012-1 2012-2013-1 2013-2014-1 2014-2015-1	32 32 32 32	6 12 6 6	本科生	4	必修课
	F10D3640	食品药品和医疗器械的安全性评价	2011-2012-2 2012-2013-2 2013-2014-2	24 24 24	20 18 18	本科生	3	选修课
	F10C3270	组织工程与人工器官	2011-2012-2 2012-2013-2 2013-2014-2	32 32 32	2 4 2	本科生	3	选修课
	F10D3650	生物产业政策与法规	2012-2013-2 2013-2014-2	16 16	2 2	本科生	2	选修课
	F10D3360	医疗器械规范与法规	2012-2013-1 2013-2014-1 2014-2015-1	16 16 16	2 4 4	本科生	3	选修课
	G10C4430	专业综合实验	2011-2012-1 2012-2013-1 2013-2014-1	10 周 16 周 16 周	40 40 40	本科生	3	必修课
	C10B2171	生物医学工程研究方法	2015-2016-2	32	8	本科生	1	必修课

注：课程性质为校级核心、专业基础核心、专业方向核心、必修、选修、公共选修等。

院(系)确认人签字：

教务处确认人签字：周海

教学含成教果材奖	获奖时间	获奖项目名称		获奖等级	本人排名
教学研究	起止时间	教改立项项目名称（含编写教材、讲义）	项目来源	完成情况	本人作用
	2013.12-2015.12	面向生物医学工程专业的实验动物学课程建设与实践	校级一般项目	已结题	主持
	2014.12-2016.12	《组织工程》课程体系改革与实践	校级一般项目	建设中	主要参与人（第6）
其它	任务完成情况（含辅导员、军训、学生工作论文、指导青年教师及青年技术人员社会实践等）				本人作用

院(系)确认人签字：

教务处确认人签字：

本人确认表内所填内容属实　签名：

院(系)确认人签字（公章）：

教务处确认盖章：

日期：

三、研究生教学工作量

教学工作量	课程名称	起止时间	课程学时	本人授课学时	授课对象（研究生/留学生等）	授课次数（几轮次）	课程类型

院(系)确认人签字：
研究生院确认人签字：

教学成果奖	获奖时间	获奖项目名称		获奖等级	本人排名
教学研究	时间	项目名称	项目来源	完成情况	本人作用
	2011.10-2012.10	生物医学工程学科跨专业研究生专业适应问题研究	研究生教育与发展研究专项基金	已结题	主要参与人（第 11）
其它	任务完成情况（含辅导员、学生工作论文、指导青年教师及青年技术人员社会实践等）				本人作用

院(系)确认人签字：
研究生院确认人签字：

本人确认表内所填内容属实　签名：
院(系)确认人签字（公章）：
研究生院确认人签字（公章）：
日期：

2016年专业技术职务评聘专利与获奖情况认定表

单位	生物与医学工程学院	姓名	王江雪	工作证号	08510	任职时间	2007.07

1.获批专利情况

任现职以来以第一享有人（含学生第一本人第二）名义共授权专利 1 项；任现职以来共获得已授权专利情况：

类 别	专利数	发明专利	实用新型	外观设计
第一享有人	1	1		
总数量	1	1		

序号	专利名称	专利类型	授权日期	批准机构	专利号	仅限首次授权		
						权利单位	人数	本人排名
1	原位测试定位可控力学加载固定装置	发明专利	2013.09.11	中华人民共和国国家知识产权局	CN：ZL201110320495.2	北航	5	第一
2								
3								
4								
5								
6								
7								
8								

本人承诺以上所填属实。

承诺人：王江雪　　学院审核人（盖章）：

科研部门审核意见：

经审核，上表所列奖项中，符合首次授权状态的归档专利共 1 项（序号： 1 ）。

审核人：　　盖章：

2.获奖情况

任现职以来获得国家级教学/科研成果奖__项；省部级教学/科研成果一等奖前五名、二等奖前三名或三等奖第一完成人共__2__项。请填写任现职以来获得教学、科研、管理奖励情况。

序号	奖励名称	颁奖部门	奖励级别	获奖时间	人数	本人排名
1	“蓝天新秀”称号	北京航空航天大学	校级	2009	1	第一
2	第43批中国博士后科学基金二等资助	中国博士后科学基金会	部级	2008	1	第一
3						
4						
5						
6						

本人承诺以上所填属实。

承诺人：王江雪　　学院审核人（盖章）：

科研部门审核意见：

经审核，上表所列奖项中，情况属实的国家级科研成果奖___项（序号：　　），省部级科研成果___项（序号：　　）。

审核人：　　盖章：

注：1.申请人认真如实填写相关信息后A4纸单面打印；
2.申请人签字确认后将此表及相关证明材料交至所在学院，由学院统一送至科研院审核；
3.申请人填写申报材料时以审核后的信息为准。

课题信息查询

经费负责人：王江雪　　工作证号：08510　　查询范围：2007-07-01到2016-05-01

总实到经费：130.92

单位：万元

编号	经费号	项目名称	项目来源	实到经费	设备费	外协费	课题性质	项目负责人
1	30-4526-01	晚期糖基化终末产物（AGEs）对骨形成及骨吸收的影响	教育部	11.99981	2	0	非51合同	王江雪
2	37-5855	纳米TiO2的结构特征影响骨形成能力的研究	国家基金委	80	1.5	0	非51合同	王江雪
3	30-2563	纳米TiO2的结构特征影响骨形成能力的研究	教育部	14.92	0	0	非51合同	王江雪
4	30-2132	介入式主动脉瓣的研发	教育部	3.99999	0	0	非51合同	王江雪
5	37-4155	膝关节腔注射氧化钛纳米颗粒的生物性研究*	国家基金	20	0	0	非51合同	王江雪

科学技术研究院

查询日期：2016年05月25日

证明

兹证明生物与医学工程学院王江雪同志（职工编号：08510），于2009年获批北航“蓝天新秀”称号。

特此证明。

2016年5月27日

中国博士后科学基金

资助证书

经专家评审，北京航空航天大学　王江雪

博士后，获得第　四十三　批中国博士后科学

基金　二　等资助金。

中国博士后科学基金会

编号：200804303049

2008 年　8 月　12 日

留学回国人员证明

（2015）温哥华 教(文) 证字 151136 号

兹证明 王江雪 （男□、女☑，护照号码 E18694790 ）系我国在 加拿大 国 University of British Columbia 学校（单位）的高级研究学者□、访问学者☑、博士后□、博士研究生□、硕士研究生□、本科生□、大专生□、其他留学人员□

在我驻外使（领）馆报到日期 2015 年 11 月 15 日

注册入学日期 2015 年 01 月 28 日

毕（结）业日期 2016 年 01 月 27 日

拟回国日期 2016 年 02 月 01 日

毕（结）业证书名称 Certificate 号码 _____

备注（留学经历描述） _____

留学回国人员签字：

经办人签字：

负责人签字：

教育（文化）处（组） 公章

2015 年 12 月 04 日

第一联：交留学回国人员

教育部国际合作与交流司 2012 年制表

注意事项

1、本证明只为学成回国工作的留学人员开具。
2、本证明由我驻外使（领）馆教育（文化）处（组）在留学人员回国时填写，不得涂改。
3、本证明经使（领）馆教育（文化）处（组）经办人、负责人签字并在第一、第二联加盖公章方为有效。
4、第一联由留学人员保存，其他单位可查验原件，收存复印件，不得收取原件。


27
签证
VISAS
CANADA BORDER SERVICES AGENCY
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中国边检 CHINA
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W-01FEB2016
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CANADA
ISSUED AT / DÉLIVRÉ À
BEIJING
DATE OF ISSUE / DATE D'ÉMISSION
19/11/2014
EXPIRY DATE / DATE D'EXPIRATION
01/02/2016
No. OF ENTRIES / N° D'ENTRÉES
MULTIPLE
DOCUMENT No. / N° DU DOCUMENT
E725672352
CATEGORY / CATÉGORIE
W-1
WORKER
SURNAME / NOM DE FAMILLE
GIVEN NAME / PRÉNOM
WANG, JIANGXUE
PASSPORT No. / N° DU PASSEPORT
E18694790
PERSON(S) / PERSONNE(S)
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26

教育部出国留学人员培训部

结 业 证 书

学员王江雪，女，1978 年 12 月 17 日出生，于 2013 年 3 月至 2013 年 6 月参加北京语言大学出国留学人员培训部英语高级班培训。经统一考试，成绩合格，准予结业。

北 京 语 言 大 学
出国留学人员培训部
二〇一三年六月

证书编号：1306357

CERTIFICATE

FOR GOVERNMENT-SPONSORED SCHOLARS GOING TO STUDY ABROAD

It is hereby certified that Ms. **WANG JIANGXUE**, born on Dec. 17, 1978, took the **Advanced** English Training Program at the Pre-departure Training Department, BLCU, affiliated with the Ministry of Education, from March 2013 to June 2013, and has passed the required tests with satisfactory scores.

Signature:

Dean of the Department for Pre-departure Training
Beijing Language and Culture University
Issued in June 2013

国家公派留学人员

英语培训成绩单

学员 **王江雪** 于二〇一三年三月至二〇一三年六月在我部参加英语培训，并参加国家留学基金管理委员会统考。成绩如下：

项目	成绩
听力 （满分 40，及格 20）	**34**
阅读 （满分 40）	**25**
写作 1 （满分 15）	**9**
写作 2 （满分 25）	**14**
口语 （满分 30，及格 18）	**21**
平时成绩与考勤 （10 分）	**10**
总成绩 （满分 160 分，及格 90）	**113**

北京语言大学
出国留学人员培训部
二〇一三年七月

博士学位证书

王江雪系 河北省晋州市人，一九七八年十二月十七日生。在我中科院高能物理研究所粒子物理与原子核物理学科（专业）已通过博士学位的课程考试和论文答辩，成绩合格。根据《中华人民共和国学位条例》的规定，授予理学博士学位。

中国科学院研究生院院长

学位评定委员会主席

二〇〇七年七月七日

证书编号 8000122007001358

中国科学院

研究生院博士研究生

毕 业 证 书

中 国 科 学 院 研 究 生 院 印 制

No. 0035491

研究生 王江雪 性别 女，

一九七八 年 十二 月 十七 日生，于

二〇〇四 年九 月至二〇〇七 年七 月在

中国科学院高能物理研究所

粒子物理与原子核物理 专业

学习，学制 三 年，修完博士研究生培养计划规定的全部课程，成绩合格，毕业论文答辩通过，准予毕业。

研究生培养单位 中国科学院研究生院

负责人：陈和生 院长：白书诚

二〇〇七 年七 月一 日

编号：800011200701070535

中华人民共和国教育部监制