## CONTENTS

### Aquatic environment

Effects of physical and chemical characteristics of surface sediments in the formation of shallow lake algae-induced black bloom
Qiushi Shen, Cheng Liu, Qinlin Zhou, Jingge Shang, Lei Zhang, Chengxin Fan

A fishy odor episode in a north China reservoir: Occurrence, origin, and possible odor causing compounds
Yunyun Zhao, Jianwei Yu, Ming Su, Wei An, Min Yang

Advanced lignin-acrylamide water treatment agent by pulp and paper industrial sludge: Synthesis, properties and application (Cover story)
Hongyan Rong, Baoyu Gao, Yanxia Zhao, Zhonglian Yang, Yan Wang, Qiyan Yue, Qian Li

Effect of dissolved organic matter on sorption and desorption of phenanthrene onto black carbon
Jinghuaan Zhang, Mengchang He

Biosorption of clofibrate acid and carbamazepine in aqueous solution by agricultural waste rice straw
Zhangguang Liu, Xuefei Zhou, Xiaohua Chen, Chaomeng Dai, Juan Zhang, Yali Zhang

Effects of idle time on biological phosphorus removal by sequencing batch reactors
Dawen Gao, Hang Yin, Lin Liu, Xing Li, Hong Liang

Oxidation behavior of ammonium in a 3-dimensional biofilm-electrode reactor
Jingxing Tang, Jingsong Guo, Fang Fang, Youpeng Chen, Lijing Lei, Lin Yang

Isolation of a salt tolerant laccase secreting strain of *Trichoderma* sp. NFCCI-2745 and optimization of culture conditions and assessing its effectiveness in treating saline phenolic effluents
LM. Divya, G. K. Prasanth, C. Sadasivan

### Atmospheric environment

Estimation of carbon dioxide flux and source partitioning over Beijing, China
Tao Song, Yuesi Wang, Yang Sun

### Terrestrial environment

Changes in heavy metal contents in animal feeds and manures in an intensive animal production region of China
Hui Wang, Yuanhua Dong, Yunya Yang, Gurpal S. Toor, Xumei Zhang

Polybrominated diphenyl ethers in soil from three typical industrial areas in Beijing, China
Yongfei Zhang, Shan Fu, Xinchun Liu, Zheng Li, Yuan Dong

Water extraction kinetics of metals, arsenic and dissolved organic carbon from industrial contaminated poplar leaves
Muhammad Shahid, Tianxian Xiong, Maryse Castrec-Rouelle, Tibo Leveque, Camille Dumat

### Environmental catalysis and materials

Photocatalytic activity of TiO$_2$ containing anatase nanoparticles and rutile nanoflower structure consisting of nanorods
Zhiquan He, Qiaolan Cai, Huiling Fang, Guohua Siti, Jianping Qu, Shuang Song, Jianneng Chen

Fe$_2$O$_3$ particles as superior catalysts for low temperature selective catalytic reduction of NO with NH$_3$
Xiaobo Wang, Keiting Gui

Mercury removal using ground and calcined mussel shell
Susana Peña-Rodríguez, Alipio Bermúdez-Cousso, Juan Carlos Nóvoa-Muñoz, Manuel Arias-Estévez, María J. Fernández-Sanjurjo, Esperanza Álvarez-Rodríguez, Avelino Núñez-Delgado

Enhanced photocatalytic activity of quantum-dot-sensitized one-dimensionally-ordered ZnO nanorod photocatalyst
Jinhua Zhuang, Song Liu, Lei Kuang, Yongdan Zhao, Tao Jiang, Shiyou Liu, Xijin Xu

Effect of chromium oxide as active site over TiO$_2$-PILC for selective catalytic oxidation of NO
Jingxin Zhang, Shule Zhang, Wei Cai, Qin Zhong

Catalytic evaluation of promoted CeO$_2$-ZrO$_2$ by transition, alkal, and alkaline-earth metal oxides for diesel soot oxidation
Ali Almezhabchamarketi, Ahas Ali Khoddadadi, Yadollah Mortazavi, Ahmad Nemati

Effects of amine, amine salt and amide on the behaviour of carbon dioxide absorption into calcium hydroxide suspension to precipitate calcium carbonate
Wittaya Chauijw, Mitsuru Nakano, Kazumasa Takatori, Toshiya Kojima, Yoshiaki Wakimoto, Yoshiaki Fukushima
Effect of chromium oxide as active site over TiO$_2$-PILC for selective catalytic oxidation of NO

Jingxin Zhang$^{1,2}$, Shule Zhang$^{1,2}$, Wei Cai$^{1,2}$, Qin Zhong$^{1,2,*}$

1. School of Chemical Engineering, Nanjing University of Science and Technology, Nanjing 210094, China. E-mail: zjx1106@gmail.com
2. Nanjing AIREP Environmental Protection Technology Co., Ltd., Nanjing 21000, China

Received 24 October 2012; revised 29 April 2013; accepted 13 May 2013

Abstract

This study introduced TiO$_2$-pillared clays (TiO$_2$-PILC) as a support for the catalytic oxidation of NO and analyzed the performance of chromium oxides as the active site of the oxidation process. Cr-based catalysts were prepared by a wet impregnation method. It was found that the 10 wt.% chromium doping on the support achieved the best catalytic activity. At 350°C, the NO conversion was 61% under conditions of GHSV = 23600 hr$^{-1}$. The BET data showed that the support particles had a mesoporous structure. H$_2$-TPR showed that Cr(10)TiP (10 wt.% Cr doping on TiO$_2$-PILC) clearly exhibited a smooth single peak. EPR and XPS were used to elucidate the oxidation process. During the NO + O$_2$ adsorption, the intensity of evolution of superoxide ions (O$_2^-$) increased. The content of Cr$^{3+}$ on the surface of the used catalyst was 40.37%, but when the used catalyst continued adsorbing NO, the Cr$^{3+}$ increased to 50.28%. Additionally, O$_2$/O$_2^-$ increased markedly through the oxidation process. The NO conversion decreased when SO$_2$ was added into the system, but when the SO$_2$ was removed, the catalytic activity recovered almost up to the initial level. FT-IR spectra did not show a distinct characteristic peak of SO$_2^2$.

Key words: selective catalytic oxidation; chromium oxide; TiO$_2$-pillared clay

DOI: 10.1016/S1001-0742(12)60335-0

Introduction

NO$_x$ is a major source of air pollution. As recorded, about 49% of NO$_x$ is emitted from transportation and 46% from power plants (Klose and Rincón, 2007). Several methods including selective catalytic reduction and selective non-catalytic reduction are used in the abatement of NO$_x$ from power plants. NO from the flue gases is reduced by ammonia in excess oxygen to molecular nitrogen and water (Takahashi et al., 2007; Liu et al., 2011, 2012; Irfan et al., 2008, 2011). However, NH$_3$ may cause high cost and possible corrosion. Catalytic oxidation of NO to NO$_2$ is an ideal approach to selective catalytic reduction (SCR), and considerable interest has recently been shown in the process of developing catalysts for oxidizing NO into NO$_2$. With the appropriate ratio of NO/NO$_x$ = 50%–60%, the maximum absorption efficiency could be achieved. Subsequently, the mixed gases (NO and NO$_2$) are absorbed by lime, NaOH and ammonia (Huang et al., 2009; Long and Yang, 2000).

Montmorillonites (MMT) are one kind of cationic clays (Long and Yang, 2000; Chmielarz et al., 2003). The cations of MMT can be easily replaced by large polynuclear cations, which enable the formation of stable metal oxide pillars during thermal treatment that permanently link the silicate layers. Such pillared clays (PILCs) have been extensively studied as an attractive catalyst support (Chmielarz et al., 2003; Huang et al., 2010; Bineesh et al., 2010). TiO$_2$-PILC has a broad range of applications in the removal of heavy metals from wastewater, the photodecomposition of pollutants, acid-catalyzed reactions and the catalytic removal of volatile organic compound (Huang et al., 2010). Some works (Long and Yang, 1999, 2000; Yang and Li, 1995) have proved that TiO$_2$-PILC is a promising support for the SCR reaction. We proposed to use TiO$_2$-PILC as the support in the research of selective catalytic oxidation (SCO) due to its cheap price and stable properties.

Weiss and Iglesia (2010) carried out research on the mechanism of NO oxidation catalysis on Pt clusters using kinetic and isotopic methods. Wu et al. (2011) investigated the mechanism for MnOx supported on TiO$_2$. However, few studies have been concerned with the possible pro-
cess of NO oxidation to NO$_2$ over Cr oxide catalysts. Additionally, the poisoning action of SO$_2$ is a necessary factor we need to consider. In our study, Cr-based catalysts showed improved SO$_2$ resistance and recovery, which was much different from other transition metals (Huang et al., 2009; Tang et al., 2011) and of great importance for the application of SCO and the improvement of Cr catalysts.

1 Experimental

1.1 Catalyst preparation

The starting material was montmorillonite (Zhejiang Institute of Geology & Mineral Resources) with a composition of SiO$_2$ (61.54%), Al$_2$O$_3$ (19.88%), Fe$_2$O$_3$ (2.12%), K$_2$O (0.32%), Na$_2$O (0.02%), CaO (2.8%), and MgO (3.96%). The cation exchange capacity is 102 mequiv/100 g. The pillaring agent was prepared by adding Ti(O$\text{C}_2$H$_5$)$_4$ (Shiyi Chemical Corporation, Shanghai, China) into 5 M HCl and diluting with deionized water to pH 1.00. Then the mixture was washed until no Cl$^-$ ion could be detected. The sample was dried at 120°C overnight and calcined in air at 500°C for 3 hr. The catalysts were prepared by an impregnation method. The precursor Cr(NO$_3$)$_3$·9H$_2$O (China National Medicines Corporation Ltd.) was added to TiP in 50 mL deionized water under stirring at 60°C for 2 hr. The impregnated product was then dried at 120°C overnight and calcined in air at 500°C for 3 hr. The catalysts are denoted as Cr$(X)$TiP. $X$ (%) refers to the weight ratio of Cr in the catalyst.

1.2 Catalyst characterization

Textural properties of the samples were measured by nitrogen adsorption/desorption at −196°C using a V-Sorbet 2800S automated gas sorption system. Microstructures of the catalysts were observed by TEM microscopy using a Tecnai 12 Philips instrument operated at 120 kV. H$_2$ temperature-programmed reduction (H$_2$-TPR) was measured using a thermal conductivity detector (TCD) on a Quanta Chembet (3000) system with 5 vol.% H$_2$/Ar and 0.4 g of the catalyst at a total flow of 60 mL/min. X-ray photoelectron spectroscopy (XPS) analysis was conducted using a Thermo ESCALAB 250 with Al K$_\alpha$ ($h\nu = 1486.6$ eV) as radiation source at an accelerating power of 150 W. The electron paramagnetic resonance (EPR) measurements were made at room temperature using a Bruker EMX-10/12-type spectrometer in the X-band. Fourier transform infrared spectroscopy (FT-IR) was used to determine sulfur-containing species formed on the catalyst surface.

1.3 Catalytic activity test

The catalytic oxidation of NO was carried out in a fixed-bed flow reactor at atmospheric pressure. Catalysts were placed in the quartz reactor (i.d. 6.8 mm) inside the fixed-bed flow reactor. A gas mixture containing 400 ppm NO, 8% O$_2$, 200 ppm SO$_2$ (when used) and N$_2$ for balance was fed into the reactor at a total flow rate of 100 mL/min. Before the reaction, the catalyst sample was pre-adsorbed by the reaction mixture to avoid any influence caused by NO adsorption on the catalyst. The concentration of NO, NO$_2$ and SO$_2$ were analyzed by a MRU Vario Plus flue gas analyzer (Germany) and the NO conversion is defined as follows:

$$\text{NO conversion to NO}_2 = \frac{[\text{NO}_{\text{in}} - \text{NO}_{\text{out}}]}{\text{NO}_{\text{in}}} \times 100\%$$

2 Results and discussion

2.1 NO oxidation activity

As shown in Fig. 1, the change of catalytic activity clearly keeps rising with the increase of the reaction temperature. The temperature played an important role on the NO conversion over the chromium-based catalysts. A series of tests were carried out between 150 and 350°C to ascertain the best level of Cr doping on the support. At low temperature (under 200°C), the conversion of NO was under 20%. In this temperature range, the highest temperature (350°C) gave the highest NO conversion. The trend of the conversions was similar to that presented by Shiba et al. (1996). A series of tests were carried out to ascertain the best ratio of Cr doping on the support. From Fig. 1, the conversion of NO decreased in the following order: Cr(10)TiP > Cr(12)TiP > Cr(8)TiP > Cr(5)TiP. Since 10 wt.% Cr doping on the support achieved the best catalytic activity, all the subsequent studies were based on Cr(10)TiP.

![Fig. 1](image-url)
Table 1  Surface area, pore volume and pore size of support and Cr(10)TiP

<table>
<thead>
<tr>
<th>Sample</th>
<th>Surface area (m²/g)</th>
<th>Pore volume (cm³/g)</th>
<th>Pore size (nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TiO₂</td>
<td>14.4</td>
<td>0.024</td>
<td>5.28</td>
</tr>
<tr>
<td>TiP</td>
<td>198.6</td>
<td>0.117</td>
<td>4.98</td>
</tr>
<tr>
<td>CrTiP</td>
<td>143.3</td>
<td>0.097</td>
<td>5.39</td>
</tr>
</tbody>
</table>

2.2 Catalyst characterization

The detailed structural parameters, including surface areas, pore volume and pore size, were measured using N₂ adsorption, and the results are summarized in Table 1. TiO₂-PILC had a much larger surface area compared to the pure TiO₂. The surface area of the TiP support was 198.6 m²/g and after the 10 wt.% chromium doping, the surface area of the catalyst was 143.3 m²/g. Figure 2 shows the nitrogen adsorption-desorption isotherms of the TiP. The isotherms and hysteresis loops of the support are the typical type IV isotherms and type H2 according to the IUPAC classification. Type H2 demonstrates that the pores are complex but have a relatively uniform distribution (Xin, 2009). The desorption branch shows an inflection “knee” at 0.45–0.50 of P/P₀, which has been observed for many different types of layered materials when nitrogen is used as the adsorbent gas (nitrogen boils at P/P₀ 0.42) (Yuan et al., 2006). It is sometimes called the tensile strength artifact due to the complexity of capillary condensation in pore networks with pore blocking effects (Huang et al., 2010). The TiP particles have a pore size distribution centered between 2.5 and 10 nm, which belongs to the category of mesopores.

Figure 3 shows the TEM image of Cr(10)TiP. We can find that the Cr(10)TiP particles were round-shaped and the average particle size was less than 25 nm. The particles were well dispersed but some parts of the catalyst showed slight agglomeration.

H₂-TPR for the Cr(10)TiP catalyst and the pure support were conducted. As shown in Fig. 4, the pure support did not show a reduction process in the H₂ adsorption and desorption. The experimental reduction data of the Cr(10)TiP clearly exhibited smooth single-peak behavior, so that only one dominant reduction process was taking place. The chromium oxide species revealed two evident
valences. CrO$_3$ reduces in one step to Cr$_2$O$_3$ at 360°C, but Cr$_2$O$_3$ is hardly reduced further in the H$_2$ reduction process (Kanervo and Krause, 2002).

2.3 A possible oxidation process over the catalyst

A possible oxidation process over the catalyst is shown in the Fig. 5. In order to prove this oxidation process, EPR and XPS were applied.

The superoxide ion in surface-chemisorbed oxygen is the key species for NO oxidation to nitro and nitrate groups (Wang et al., 2001). The EPR spectra of O$_2$ and O$_2$+ NO adsorption over Cr(10)TiP are shown in Fig. 6. We detected signals at $g = 2.0086$ and $g = 2.0057$, which demonstrated the existence of superoxide ions (Howe and Gratzel, 1987). The peaks of $g = 1.9753$ and $g = 1.9747$ are attributed to Ti$^{3+}$ (Kumar et al., 2006). It also can be seen that when NO and O$_2$ were adsorbed simultaneously, the intensity of the evolution of superoxide ions increased. The O$_2^-$ reacted with the intermediate NO$^+$, which then turned into NO$_3^-$ (Wang and Chen, 2001) reported that NO could react with NO$_3^-$ to form NO$_2^-$, and then NO$_2^-$ reacted with NO$_3^-$ to form NO$_2$.

To investigate the surface chemical states of the most active catalyst, the XPS Cr 2p$_{3/2}$ and O 1s spectra were obtained (Figs. 7 and 8). Two main peaks due to Cr 2p$_{3/2}$ and Cr 2p$_{1/2}$ were observed. By performing a peak-fitting deconvolution, the Cr 2p$_{3/2}$ peak ranging from 574 to 582 eV could be separated into two peaks. The “high valence” Cr$^{6+}$ occurred at 579–580 eV and the “low valence” Cr$^{3+}$ had a binding energy 576.9 eV (Fountzoula et al., 1997). Thus, the two chromium oxidation states exist on the catalyst. It was found that the relative surface concentration of chromium oxide varied significantly after the operations. The Cr$^{3+}$ on the surface of the used catalyst was...

![Fig. 5](image1)

**Fig. 5** Oxidation process over the Cr(10)TiP. NO$^+$: intermediate.

![Fig. 6](image2)

**Fig. 6** EPR spectrum comparison of Cr(10)TiP+O$_2$ and Cr(10)TiP+O$_2$+NO.

![Fig. 7](image3)

**Fig. 7** XPS spectra of O.

![Fig. 8](image4)

**Fig. 8** XPS spectra of Cr. (a) catalyst used under atmosphere of NO + O$_2$ (N$_2$ as balance); (b) on the basis of (a), removing the O$_2$ with the catalyst used in NO (N$_2$ as balance).
53.63%, but when the used catalyst continued to adsorb NO, the content of Cr\(^{3+}\) increased to 59.88% (Table 2). This result proves that the NO was adsorbed on the Cr\(^{6+}\) in the oxidation process. Cr\(^{6+}\) is the center of the active site. The O1s peaks of these two catalysts are shown in Fig. 7. The peak at 529–530 eV corresponds to lattice oxygen (hereafter denoted as O\(_{\text{L}}\)), whereas the binding energy of 531–533 eV may be assigned to chemi-sorbed oxygen (hereafter denoted as O\(_{\text{C}}\)) (Bensalem et al., 1995).

Through the oxidation process, O\(_{\text{L}}$/O\(_{\text{C}}\) increased notably, which was the result of adsorbed oxygen (O\(_{\text{2}}\)) increasing.

2.4 Effect of SO\(_2\)

SO\(_2\) was fed into the system to analyze the sulfur resistance of the catalyst. The experimental result is shown in Fig. 9. The results show that the NO conversion decreased when 200 ppm SO\(_2\) was added into the system. The lowest NO conversion at this situation was 20% but fortunately, when the SO\(_2\) was removed, the catalytic activity recovered almost up to the initial level. FT-IR spectra of the fresh catalyst and the catalyst under SO\(_2\) are shown in Fig. 10. The peak at 1030 cm\(^{-1}\) corresponds to the Si-O-Si stretch in the clay (Bineesh et al., 2010). There was no distinct characteristic peak at 1140 cm\(^{-1}\) corresponding to SO\(_4^{2-}\). The result indicated that no active component formed metal sulfates, and this could explain why the activity recovered almost up to the original level in the end. We thought that the SO\(_2\) and NO were absorbed on the active site of the catalysts competitively, and the SO\(_2\) occupied more sites than NO. Thus the NO conversion decreased. When SO\(_2\) was removed, the active sites were released and the catalytic activity was recovered. Compared with Mn- and Co-based catalysts (Huang et al., 2009; Tang et al., 1997), Cr showed a better SO\(_2\) resistance performance and could be recovered. The previous literature (Ordóñez et al., 2008) has proved that CrO\(_x\) had excellent resistance to SO\(_2\) and was without appreciable deactivation during more than 40 hr in the oxidation of methane. Our experiment is of great importance for the application of SCO and the improvement of Cr catalysts.

3 Conclusions

Cr-based oxides doped on TiP for the selective catalytic oxidation were developed. 10 wt.% Cr doping on the support achieved the best catalytic activity in the temperature range of 150–350°C under flow conditions of GHSV = 23600 hr\(^{-1}\). The BET data showed that the TiP particles have a pore size distribution centered between 2.5 and 10 nm, which belongs to the category of mesopores. Cr(10)TiP particles were round-shaped and the average particle size was less than 25 nm. From the H\(_2\)-TPR result, it was found that CrO\(_3\) was reduced in one step to Cr\(_2\)O\(_3\).

<table>
<thead>
<tr>
<th>XPS spectra</th>
<th>Element valance</th>
<th>Fresh catalyst</th>
<th>Used catalyst</th>
<th>Used catalyst + NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cr 2p</td>
<td>Cr(^{3+})</td>
<td>–</td>
<td>53.63%</td>
<td>59.88%</td>
</tr>
<tr>
<td>Concentration (%)</td>
<td>Cr(^{6+})</td>
<td>–</td>
<td>46.37%</td>
<td>40.12%</td>
</tr>
<tr>
<td>O 1s</td>
<td>O(<em>{\text{L}}$/O(</em>{\text{C}})</td>
<td>7.34</td>
<td>11.15</td>
<td>–</td>
</tr>
</tbody>
</table>

Fig. 7 XPS spectra of two catalysts with different valence states.

Fig. 9 Catalytic oxidation of NO at 300°C over Cr(10)TiP. Conditions: NO 400 ppm, O\(_2\) 8%, SO\(_2\) 200 ppm, N\(_2\) as the balance gas, GHSV = 23600 hr\(^{-1}\).

Fig. 10 FT-IR of the Cr(10)TiP fresh and used in SO\(_2\).
at 350°C but that Cr$_2$O$_3$ was hardly reduced further, so only one dominant reduction process took place. From the EPR spectra, we detected signals at $g \approx 2.0086$ and $g \approx 2.0057$, which demonstrated the existence of superoxide ions. The O$_2^-$ reacted with the intermediate NO$, which then turned into NOO$^-$.

The XPS spectra demonstrated that the NO was adsorbed on the Cr$^{VI}$ in the oxidation process and furthermore, Cr$^{IV}$ was the center of the active site. In the SO$_2$ deactivation experiments, the catalytic activity recovered almost up to the initial level when SO$_2$ was removed. Cr showed better SO$_2$ resistance performance than comparable transition metal oxide catalysts.

**Acknowledgments**

This work was supported by the Assembly Foundation of the Industry and Information Ministry of China 2012 (543), the National Natural Science Foundation of China (No. U1162119, 51078185), the Scientific Research Project of Environmental Protection Department of Jiangsu Province (No. 2013003, 201112), the Research Fund for the Doctoral Program of Higher Education of China (No. 201113219110009), the Industry-Academia Cooperation Innovation Fund Projects of Jiangsu Province (No. BY2012025) and the research fund of Key Laboratory for Advanced Technology in Environmental Protection of Jiangsu Province (No. AE201001).

**References**


Editorial Board of Journal of Environmental Sciences

Editor-in-Chief
Hongxiao Tang
Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, China

Associate Editors-in-Chief
Jiuhui Qu
Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, China
Shu Tao
Peking University, China
Nigel Bell
Imperial College London, United Kingdom
Po-Keung Wong
The Chinese University of Hong Kong, Hong Kong, China

Editorial Board
Aquatic environment
Baoyu Gao
Shandong University, China
Maoshong Fan
University of Wyoming, USA
Chihpin Huang
National Chiao Tung University
Taiwan, China
Ng Wun Jern
Nanyang Environment & Water Research Institute, Singapore
Clark C. K. Liu
University of Hawaii at Manoa, USA
Hokyong Shon
University of Technology, Sydney, Australia
Zijian Wang
Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, China
Zhiwu Wang
Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, China

Crop environment
Guibin Jiang
Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, China
Jae-Sung Lee
Hanyang University, South Korea

Atmospheric environment
Jianmin Chen
Fudan University, China
Abdelwahid Melloul
Centre National de la Recherche Scientifique
France
Yujing Mu
Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, China
Min Shao
Peking University, China
James Jay Schauer
University of Wisconsin-Madison, USA
Yuesi Wang
Institute of Atmospheric Physics, Chinese Academy of Sciences, China
Xin Yang
University of Cambridge, UK

Environmental biology
Yong Cai
Florida International University, USA
Jaes-Eong Lee
Hanyang University, South Korea
Christopher Rensing
University of Copenhagen, Denmark
Bojan Sedmak
National Institute of Biology, Ljubljana
Lirong Song
Institute of Hydrobiology, Chinese Academy of Sciences, China
Gehong Wei
Northwest A & F University, China
Daqiang Yin
Tongji University, China
Zhongtang Yu
The Ohio State University, USA

Environmental catalysis and materials
Tsuyoshi Nakanishi
Gifu Pharmaceutical University, Japan
Willie Peijnenburg
University of Leiden, The Netherlands
Bingsheng Zhou
Institute of Hydrobiology, Chinese Academy of Sciences, China

Environmental toxicology and health
Jingwen Chen
Dalian University of Technology, China
Jianying Hu
Peking University, China
Guibin Jiang
Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, China
Sijin Liu
Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, China

Environmental analysis and method
Yong Cai
Florida International University, USA
Chuanjiang Wang
National Natural Science Foundation of China

Municipal solid waste and green chemistry
Pinjing He
Tongji University, China

Copyright © Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences. Published by Elsevier B.V. and Science Press. All rights reserved.
Aims and scope

*Journal of Environmental Sciences* is an international academic journal supervised by Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences. The journal publishes original, peer-reviewed innovative research and valuable findings in environmental sciences. The types of articles published are research article, critical review, rapid communications, and special issues.

The scope of the journal embraces the treatment processes for natural groundwater, municipal, agricultural and industrial water and wastewaters; physical and chemical methods for limitation of pollutants emission into the atmospheric environment; chemical and biological and phytoremediation of contaminated soil; fate and transport of pollutants in environments; toxicological effects of terrorist chemical release on the natural environment and human health; development of environmental catalysts and materials.

For subscription to electronic edition
Elsevier is responsible for subscription of the journal. Please subscribe to the journal via http://www.elsevier.com/locate/jes.

For subscription to print edition
China: Please contact the customer service, Science Press, 16 Donghuangchenggen North Street, Beijing 100717, China. Tel: +86-10-64017032; E-mail: journal@mail.sciencep.com, or the local post office throughout China (domestic postcode: 2-580).
Outside China: Please order the journal from the Elsevier Customer Service Department at the Regional Sales Office nearest you.

Submission declaration
Submission of an article implies that the work described has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis), that it is not under consideration for publication elsewhere. The submission should be approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out. If the manuscript accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder.

Editorial
Authors should submit manuscript online at http://www.jesc.ac.cn. In case of queries, please contact editorial office, Tel: +86-10-62920553, E-mail: jesc@263.net, jesc@rcees.ac.cn. Instruction to authors is available at http://www.jesc.ac.cn.