# China-US Joint Workshop

## "Systems Biology for Environmental Sustainability"

**May 27-28, 2013, Shenyang, China**

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# INTRODUCTION OF CONFERENCE

## Introduction

The industrial civilization created unprecedented social prosperity from the 19th century to the 20th century. Meanwhile, a series of environmental issues emerged, such as energy shortage, water pollution, and ecosystem degradation. Modern industrialization processes increasingly exhaust fossil resources and destroy eco-environmental services, inducing aggravating conflicts between human and natural systems and posing great challenges to sustainable development of human society. A key to sustainable development is the proper management of our supporting environmental systems and their services as they are the foundation of global economic activity and human well-being. The economies of the US and China are the globally dominant drivers of energy consumption, water shortage, land use change, fertilizer utilization, urban waste generation, and greenhouse gas emissions. These two nations are thus strategically linked to the challenges of global climate change, environmental pollution, food security, and sustainable development. The US and China share responsibility for developing effective strategies and practical protocols for the best solutions to environmental problems that transform the production and use of limited ecosystem and energy resources. More than ever before, these two nations need to exchange perspectives at all levels and develop a joint agenda to benefit the world.

In order to realize environmental sustainability, biological technology has been rapidly developing to eliminate environmental pollutants and produce renewable energy. In particular, the development of various 'omics' technologies (such as metagenomics, metatranscriptomics, metaproteomics, and metabonomics) and the "Big Science" (including biology, systematics, and informatics) creates systems biology, which has moved forward one giant leap for research of life science in post-genome era. Systems biology can help us understand the mechanisms governing the interactions between microbe and the environment, thus improving the efficiency of environmental remediation and bioenergy production. Also, systems biology can provide Synthetic Biology approaches to manipulating or constructing the community of functional microbes for keeping the environment to function in a sustainable manner.

## Symposium Goals and Objectives

Based on existing collaborations within the China-US Joint Research Center for Ecosystem and Environmental Change (http://jrceec.utk.edu), this bi-national workshop aims to discuss the latest advances in theories and technologies of systems biology as well as their application for environmental remediation, bioenergy production, and biogeochemical transformation. The workshop will provide an opportunity to build up a China-US joint research platform for modern environmental biotechnology. Specifically, conference sessions and panel discussion will be organized around the following topics:

- New theories, technologies and methods of systems biology

- Application of systems biology for environmental remediation
- Application of systems biology for biogeochemical characterization
- Application of systems biology for bioenergy and bioproduct production

## Organizers

- Shenyang University (Key Laboratory of Regional Environment and Eco-Remediation, Ministry of Education)
- Institute of Applied Ecology, Chinese Academy of Sciences (CAS)
- The University of Tennessee (UT)
- Oak Ridge National Laboratory (ORNL)
- Shenyang Agricultural University
- Shenyang Association of Science and Technology

## Participants

The workshop will invite approximately 30 leading scientists from the US and China for presentations and also be open to scientists and students from other US and Chinese institutions.

## Invited speakers

Dr. **Gary Sayler** Distinguished Professor and Director, UT-ORNL Joint Institute for Biological Sciences; Center for Environmental Biotechnology, The University of Tennessee.

Dr. **Terry Hazen** Governor's Chair Professor, The University of Tennessee and Oak Ridge National Laboratory.

Dr. **Frank Loeffler** Governor's Chair Professor, The University of Tennessee and Oak Ridge National Laboratory.

Dr. **Anthony Palumbo** Distinguished Staff Scientist and Director, Biosciences Division, Oak Ridge National Laboratory.

Dr. **Alice Layton** Research Associate Professor, The University of Tennessee.

Dr. **Jie Zhuang** Professor and Research Director, The University of Tennessee.

Dr. **Qi-Xing Zhou** Professor, Nankai University.

Dr. **Ling-Tian Xie** Professor, Shenyang Institute of Applied Ecology, CAS.

Dr. **Mei-Ying Xu,** Professor, Guangdong Institute of Microbiology, China.

Dr. **Jing-Kuan Wang** Professor, Shenyang Agricultural University.

Dr. **Dong-Ju Bian** Shenyang Institute of Applied Ecology, CAS.

Dr. **Li-Na Sun** Professor and Dean,, Shenyang University.

Dr. **Hai-Bo Li** Professor and Vice-dean, Professor, Shenyang University.

# ORGANIZERS AND COMMITTEE

## Chair

**Tie-Heng Sun** Academician, Shenyang University; Shenyang Institute of Applied Ecology, CAS.

## Co-Chair

**Gary S. Sayler** Distinguished Professor and Director, UT-ORNL Joint Institute for Biological Sciences; Center for Environmental Biotechnology, The University of Tennessee.

**Lan-Zhu Ji** Professor, Chair of Organizing Committee, Vice Director of IAE, CAS.

## Scientific Committee (alphabetical order)

Dr.**Tie-Heng Sun** Academician, Shenyang University; Shenyang Institute of Applied Ecology, CAS.

Dr. **Alice Layton** Research Associate Professor, The University of Tennessee.

Dr. **Anthony Palumbo** Distinguished Staff Scientist and Director, Biosciences Division, Oak Ridge National Laboratory.

Dr. **Frank Loeffler** Governor's Chair Professor, The University of Tennessee and Oak Ridge National Laboratory.

Dr. **Jiu-Hui Qu** Academician, Chinese Academy of Sciences.

Dr. **Shu Tao** Academician, Peking University.

Dr. **Terry Hazen** Governor's Chair Professor, The University of Tennessee and Oak Ridge National Laboratory.

Dr. **Ru-Song Wang** Academician, Chinese Academy of Sciences.

Dr. **Yu-Long Zhang** Professor and President, Shenyang Agricultural University.

## Organizing Committee

Dr. **Xiao-Chu Wang** Professor and Vice-President, Shenyang University.

Dr. **Li-Na Sun** Professor and Dean, Shenyang University.

Dr. **Jie Zhuang** Professor and Research Director, The University of Tennessee.

## Secretariat

**Secretary-General:**

Dr. **Xiao-Jun Hu** Professor and Vice-dean, Professor, Shenyang University.

Dr. **Jie Zhuang** Professor and Research Director, The University of Tennessee.

**Secretary:**

Dr. **Bing Wang** Shenyang University.

Dr. **Xiao-Wei Niu** Shenyang University.

Dr. **Xiang-Feng Zeng** Shenyang Institute of Applied Ecology, CAS.

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## Registration

Registration fee: free for invited participants
800 RMB for voluntary participants
400 RMB for students

# DATES AND VENUE

## Dates

May 27-28, 2013

## Venue

The conference will be convened at the Jianhui Junyue Hotel Shenyang, located at No. 77 North Station Road, Shenhe District, Shenyang, Liaoning Province, China. Detailed hotel information is available via hotel telephone +86 (24) 3128-9999 and webpage http://www.syhiyatt.com.

# China-US Joint Workshop
# "Systems Biology for Environmental Sustainability"
# Agenda

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| **May 26, 2013 (Sunday)** | |
| 8:00-22:00 | **Registration**<br>**Place:** Junyue Grand Hotel Shenyang, 1st Floor. |
| **May 27, 2013 (Monday)** | |
| 7:00-8:30 | **Breakfast**<br>**Place:** Royal Cafe, 1st Floor. |
| 8:30-9:00 | **Opening Ceremony**<br>**Chair: Lan-Zhu Ji**, Professor, Chair of Organizing Committee, Vice Director of IAE, CAS<br>**Place:** Function Room (A+B), 4th Floor. |
| | Welcome addresses by Shenyang University leader<br>Welcome addresses by Shenyang Association of Science and Technology leader<br>Welcome addresses by the scholar representative from the United States |
| 9:00-9:20 | **Photography**<br>**Place:** Ambassador Ballroom, 2nd Floor. |
| | **Plenary lecture**<br>**Chair: Lan-Zhu Ji**<br>**Place:** Function Room (A+B), 4th Floor. |
| 9:20-10:20 | **Gary Sayler**, Distinguished Professor and Director, UT-ORNL Joint Institute for Biological Sciences; Center for Environmental Biotechnology, The University of Tennessee.<br>**Title:** System Science of Bioremediation. |
| 10:20-10:35 | **Morning Tea**<br>**Place:** Function Room (A+B), 4th Floor. |
| 10:35-11:35 | **Qi-Xing Zhou**, Professor, Nankai University.<br>**Title:** Ecological Risks of Graphene Entering into the Environment. |
| 12:00-13:00 | **Lunch**<br>**Place:** Royal Cafe, 1st Floor. |
| | **Plenary lecture**<br>**Chair: Gary Sayler**<br>**Place:** Function Room (A+B), 4th Floor. |
| 13:30-14:10 | **Terry Hazen**, Governor's Chair Professor, The University of Tennessee and Oak Ridge National Laboratory.<br>**Title:** A Systems Biology Approach to Biotransformation of Heavy Metals and Radionuclides in Groundwater. |
| 14:10-14:40 | **Ling-Tian Xie,** Professor, Institute of Applied Ecology, CAS.<br>**Title:** Phylogenetic Signals and Ecotoxicological Responses-A Case Study on Cadmium Susceptibility in Aquatic Insects. |
| 14:40-15:20 | **Frank Loeffler**, Governor's Chair Professor, The University of Tennessee and Oak Ridge National Laboratory.<br>**Title:** Immobilizing a Legacy: Bacterial Reduction of Hexavalent |

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| | Uranium. |
| 15:20-15:35 | **Afternoon Tea**<br>**Place:** Place: Function Room (A+B), 4th Floor. |
| | **Plenary lecture**<br>**Chair: Qi-Xing Zhou**<br>**Place:** Function Room (A+B), 4th Floor. |
| 15:35-16:05 | **Mei-Ying Xu,** Professor, Guangdong Institute of Microbiology, China.<br>**Title:** Microbial respiration regulation for enhanced In-situ remediation of complex contaminated sediment in Pearl River Delta. |
| 16:05-16:45 | **Anthony Palumbo**, Distinguished Staff Scientist and Director, Biosciences Division, Oak Ridge National Laboratory.<br>**Title:** Recent Advances on Bacterial Community Involvement in Mercury Transformations in The Environment. |
| 16:45-17:15 | **Jing-Kuan Wang**, Professor, Shenyang Agricultural University.<br>**Title:** The fate and distribution of recently photosynthesized carbon in a maize-soil-microbial system under plastic film mulching and fertilizer application. |
| 17:15-17:45 | **Dong-Ju Bian**, Professor, Institute of Applied Ecology, CAS.<br>**Title:** A Review of Water Beetle's Research in China. |
| 18:00-20:00 | **Banquet**<br>**Place:** Taipei Restaurant, 5th Floor. Penghuwan Restaurant, 3rd Floor. |

| **May 28, 2013 (Tuesday)** | |
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| 7:00-8:30 | **Breakfast**<br>**Place:** Royal Cafe, 1st Floor. |
| | **Plenary lecture**<br>**Chair: Terry Hazen**<br>**Place:** Function Room (A+B), 4th Floor. |
| 8:30-9:10 | **Alice Layton**, Research Associate Professor, The University of Tennessee.<br>**Title:** Metagenomic Analyses Permafrost Microbial Ecosystems: A Foundation for a Systems Biology Approach to Understanding Temperature-Controlled Successions. |
| 9:10-9:40 | **Li-Na Sun**, Professor and Dean, Shenyang University.<br>**Title:** Heavy metals Pollution of Soil and Ecoremediation in Shenyang Xihe River area. |
| 9:40-9:55 | **Morning Tea**<br>**Place:** Function Room (A+B), 4th Floor. |
| | **Plenary lecture**<br>**Chair: Ling-Tian Xie**<br>**Place:** Function Room (A+B), 4th Floor. |
| 9:55-10:25 | **Jie Zhuang**, Professor and Research Director, The University of Tennessee.<br>**Title:** Colloid and Colloid-Facilitated Transport in Porous Media. |
| 10:25-10:55 | **Hai-Bo Li**, Professor and Vice Dean, Shenyang University.<br>**Title:** Research on technology integration of domestic sewage treatment in multi-cities of central Liaoning. |

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| 10:55-11:30 | **Closing Ceremony** |
| 11:30-13:00 | **Lunch**<br>**Place:** Royal Cafe, 1st Floor. |
| 14:00-18:00 | Downtown Seeing in Shenyang |

# China-US Joint Workshop
# "Systems Biology for Environmental Sustainability"
**May 27-28, 2013, Shenyang, China**

## Abstract

# Systems Biology for Environmental Sustainability

Gary Sayler et al.

*Center for Environmental Biotechnology[1], and UT-ORNL Joint Institute for Biological Sciences[2], University of Tennessee, Knoxville, TN USA 37996*
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Bioremediation is the biologically based technology, using the processes of biodegradation and biotransformation, with the goal of metabolically rendering environmental pollutants less toxic, and reducing their exposure threat to human and ecological health. The context for bioremediation is complex system analysis in that individual species functioning in communities of organisms are engaged in the processes as the technology is implemented as part of an engineered or natural attenuation solution to a pollution problem. In order to develop efficient and predictable outcomes for the technology, from its earliest inception bioremediation has been studied from a highly reductionist perspective to understand how pollutants are broken down or immobilized in the environment and which organisms are responsible for the processes involved. This perspective has become even more detailed with the advent of modern systems biology which seeks hierarchical understanding of the molecular, genetic, biochemical and metabolic determinants in order to assemble the complex processes from a linear compilation of its simplified parts. In a sense this bottoms up approach often fails because bioremediation functions as a Complex Adaptive System characterrized by emergent properties of biological communities resulting from nonlinearity, feedback and network interactions that are unknown, and often unknowable, and by the adaptive and self organizing characteristics of the system. In those predictable and successful instances it is largely the result of artificial selection (global control) imposed by an engineering solution. The system biology perspective in bioremediation is now being expanded to extend genomic information and models to metagenomic analysis at the ecosystem scale. Likewise from a top down perspective biodiversity, community homeostasis and ecosystem dynamics are providing model paradigms and hypotheses for robust system science in bioremediation.

# A Systems Biology Approach to Biotransformation of Heavy Metals and Radionuclides in Groundwater

Terry C. Hazen

*Departments of Microbiology, Civil & Environmental Engineering, and Earth and Planetary Sciences, The University of Tennessee, Knoxville, TN 37996; Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN 37831, USA*
Email: tchazen@utk.edu

Environmental biotechnology encompasses a wide range of characterization, monitoring and control or remediation technologies that are based on biological processes. Recent breakthroughs in our understanding of biogeochemical processes and genomics are leading to exciting new and cost effective ways to monitor and manipulate the environment. Indeed, our ability to sequence an entire microbial genome in just a few hours is leading to similar breakthroughs in characterizing proteomes, metabolomes, phenotypes, and fluxes for organisms, populations, and communities. Understanding and modeling functional microbial community structure and stress responses in subsurface environments has tremendous implications for our fundamental understanding of biogeochemistry and the potential for natural attenuation or bioremediation of contaminated sites. Monitoring techniques that inventory and monitor terminal electron acceptors and electron donors, enzyme probes that measure functional activity in the environment, functional genomic microarrays, phylogenetic microarrays, metabolomics, proteomics, and quantitative PCR are also being rapidly adapted for studies in environmental biotechnology. Integration of all of these new high throughput techniques using the latest advances in bioinformatics and modeling will enable break-through science in environmental biotechnology. A review of these techniques with examples from field studies and lab simulations for biotransformation of heavy metals and radionuclides in groundwater will be discussed.

# Immobilizing a Legacy: Bacterial Reduction of Hexavalent Uranium

Frank Loffler

*Departments of Microbiology and Civil & Environmental Engineering, The University of Tennessee, Knoxville, TN 37996, USA; Oak Ridge National Laboratory, Environmental Sciences Division, Oak Ridge, TN 37831, USA*
Email: frank.loeffler@utk.edu

Mining, enriching and handling of uranium for nuclear fuel and weapons production released large quantities of radionuclides into subsurface environments, including aquifers. Diverse groups of microorganisms affect the oxidation state of metals and consequently control the mobility of toxic radionuclides in groundwater. Relevant to uranium (U) redox speciation are bacteria that reduce predominantly water-soluble and mobile hexavalent U ($U^{6+}$) to $U^{4+}$, which typically forms the uraninite mineral $UO^2$ with reduced solubility. Common soil, sediment and subsurface bacteria, including Anaeromyxobacter, Shewanella and Geobacter, use $U^{6+}$ as a respiratory electron acceptor and generate immobile U4+, thus limiting U mobility in groundwater. Reduced $U^{4+}$ is susceptible to re-oxidation by oxidants (e.g., oxygen), and oxic/anoxic transition zones provide potential hot spots that control U mobility. Consequently, understanding the microbial communities and their activities at oxic/anoxic interfaces is crucial for predicting, and possibly controlling the long-term stability and fate of U. Detailed physiological studies demonstrated that Anaeromyxobacter spp. are uniquely adapted to life at oxic-anoxic transition zones where they consume oxygen and take advantage of oxidized metal species including U(IV) as electron acceptors. Among the common soil and subsurface microorganisms that recently were implicated in $U^{6+}$ reduction are Desulfitobacterium spp. Interestingly, extended X-ray absorption fine structure (EXAFS) analysis demonstrated that the U associated with the solid phase in Desulfitobacterium cultures was a mononuclear $U^{4+}$ species instead of the typical nano-particulate uraninite (UO2) with U-U coordination. Additional detailed studies indicated that solution conditions affected the solid phase U. In the presence of phosphate, non-uraninite $U^{4+}$ was formed by cultures of Proteobacteria (i.e., Anaeromyxobacter) and Firmicutes (i.e., Desulfitobacterium). In contrast, under low phosphate conditions, Desulfitobacterium cultures produced mononuclear $U^{4+}$ whereas Anaeromyxobacter spp. reduced $U^{6+}$ to U4+-uraninite. These findings suggest that distinct biomolecular $U^{6+}$ reduction mechanism(s) operate in Gram-positive Desulfitobacterium spp. and Gram-negative Anaeromyxobacter spp., emphasizing the need for detailed ecophysiological information regarding the key players affecting U speciation.

# Recent Advances on Bacterial Community Involvement in Mercury Transformations in The Environment

Anthony V. Palumbo, Jerry M. Parks, Alexander Johs, Mircea Podar, Jennifer J. Mosher, Dwayne A. Elias, Romain Bridou, Richard A. Hurt Jr., Steven D. Smith, Stephen J. Tomanicek, Yun Qian, Steven D. Brown, Craig C. Brandt, Tatiana A. Vishnivetskaya, Scott C. Brooks, Jeremy C. Smith, Judy D. Wall, and Liyuan Liang

*Biosciences Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831, USA*
Email: palumboav@ornl.gov

Contamination with mercury is an important environmental issue due to the neurotoxic properties of mercury and its magnification in the food chain. Mercury sources range from natural emissions, to emissions from coal fired power plants, and releases from industrial sources. Bacteria are intimately involved in the cycling and transformation of mercury in the environment in moving between the relatively less toxic elemental and ionic forms to methyl mercury, which is a neurotoxin and is biomagnified. The US Department of Energy has been funding a research program at the Oak Ridge National Laboratory focused on increasing the understanding of mercury transformations in the environment. One focus of the project is understanding microbial mercury methylation and the bacteria involved in that process. Early in the project, the phylogenetic composition of the surficial sediment bacterial community was examined in a stream that was subject to industrial mercury contamination and a control site. Data analysis was conducted on 16S rRNA gene pyrosequencing samples taken over three quarterly sampling periods (36 samples). The Deltaproteobacteria are the group of bacteria that are generally acknowledged to be involved in mercury methylation. Although in relatively low numbers, the most common Deltaproteobacteria in the streams were Desulfobulbus spp. There was a statistically significant correlation of methyl-mercury concentrations with several Deltaproteobacteria, including Desulfobulbus spp., Desulfonema spp., and Desulfobacca spp. Based on these results, Desulfobulbus is a considered a logical candidate as a prime methylator in this stream. Although Deltaproteobacteria have been implicated in mercury methylation, the genetic and enzymatic basis for mercury methylation has remained unknown. Recently, the Oak Ridge National Laboratory's research team has used comparative genomics in the context of biochemical pathways to identify key genes involved in mercury methylation. The basis for this comparative analysis was the sequencing of several bacteria capable of methylation under the leadership of the Oak Ridge National Laboratory's research program. The second key to the finding was the biochemical reasoning that led to a focus on finding a corrinoid protein associated with the acetyl-CoA pathway that could be required for mercury methylation. These analyses led to the discovery of a two-gene cluster which has been designated hgcAB. The involvement of these bacteria in mercury methylation has been confirmed using molecular techniques, which show that deletion of either gene halts mercury methylation. Also, this two gene cluster is present in some bacteria (e.g., specific methanogens and clostridia) that have not, as of yet, been shown to methylate mercury. Thus, the diversity of mercury methylators could be greater than previously known. These findings lay the groundwork for additional research that will increase our understanding of the transformation of mercury in the environment. An increased understanding could lead to new approaches in mercury remediation.

# Colloid and Colloid-Facilitated Transport in Porous Media

Jie Zhuang[1] and John F. McCarthy[2]

[1]*Department of Biosystems Engineering and Soil Sciences, Institute for a Secure and Sustainable Environment；*
[2]*Center for Environmental Biotechnology, The University of Tennessee, Knoxville, TN 37996, USA*
Email: jzhuang@utk.edu

Knowledge of colloid transport and mobilization in natural and engineered systems is of primary importance for the assessment and prediction of the fate and migration of colloidal contaminants (such as viruses, pathogenic bacteria, protozoans, and colloid-/nano-sized industry materials) and toxic chemicals sorbed to mobile mineral colloids. Over the past several decades, considerable advances have been made towards understanding the processes and corresponding mechanisms governing colloid deposition and transport through laboratory investigations, field studies, and numerical modeling. It has been recognized that colloid transport and mobilization is a function of many factors, including the properties of colloids and porous media, solution chemistry, and flow conditions. The dominant mechanisms controlling colloid transport and remobilization in porous media have been attributed to electrostatic, capillary, and shear forces.Electrostatic forces are an important component of the total interaction energy between colloids and the porous medium and are impacted by factors influencing the electric double layer (EDL), such as solution ionic strength, ion composition, and pH.Capillary forces describe interactions between individual colloids or between colloids and surfaces wetted by fluid and are impacted by the degree of saturation, pore sizes, contact angles of both colloids and porous media, and tension. Shear force is the shear developed on the wetted area of the pore channel. It acts in the direction of flow and is impacted by the flow velocity, liquid density, and flow path tortuosity. Most previous colloid transport studies included only steady-state flow conditions, which do not effectively represent natural vadose zones, where transient flows (e.g., infiltration and drainage) tend to dominate. More recently, several studies have addressed transient transport of colloids by studying the influence of physical and chemical perturbations on colloid transport and mobilization. It has been found that colloids respond to changes in the distribution, configuration, and total area of air–water menisci. During the drainage process, colloids accumulate in the thin water films present at air–water–solid contacts. Although there are alternative arguments in the literature describing how air–water interfaces and/or air–water–solid interfaces affect colloid retention and mobilization, it seems that changes in pore water saturation and the geometry of corner-water ducts in porous media can cause colloid remobilization. The transport of colloids under transient flow conditions is subject to the coupling of flow and chemical conditions. This is because, under certain conditions, capillary and shear forces create separation distances between colloids and pore walls beyond which the EDL is ineffective in influencing the electrostatic component of the total interaction energies, thus reducing the importance of solution chemistry on colloid retention. This presentation will summarize our recent research progresses in the research of colloid retention, transport, and remobilization under transient unsaturated flow conditions.

# Metagenomic Analyses Permafrost Microbial Ecosystems: A Foundation for a Systems Biology Approach to Understanding Temperature-Controlled Successions

Alice Layton[1], Tatiana Vishnivetskaya[1], Archana Chauhan[1], Susan Pfiffner[1], Tommy Phelps[2], Maggie C. Y. Lau[4], Brandon Stackhouse[4], Lyle Whyte[3], Nadia Mykytczuk[3], Tullis Onstott[4]

[1]*University of Tennessee, Knoxville, TN, USA;*
[2]*Oak Ridge Natioanal Laboratory, Oak Ridge, TN, USA;*
[3]*McGill University, Quebec, Canada;*
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Concern exists that Arctic wetlands may emit greenhouse gases following permafrost thawing due to microbial turnover of recalcitrant organic carbon. However, the roles that microbial communities play in gas evolution are poorly understood. In an effort to understand carbon and nitrogen cycling in a low carbon crysols a multi-"omics" approach including metagenomics, metatranscriptomics and metaproteomics is being undertaken. As a foundation for these other "omics" a metagenomic study was conducted to analyze the effect of global warming on Arctic permafrost by performing long-term thawing experiments on well-characterized, intact cores of active-layer and permafrost. Twenty 1-meter long cores with permafrost starting at 70 cm were collected from a 7-meter diameter polygon located near the McGill Arctic Research Station on Axel Heiberg Island in late April of 2011, transported frozen to Princeton University, and initiated as thawing experiments in January 2012. Experimental cores were subcategorized into cores thawed under saturated conditions, under natural hydrological conditions, in the dark, and unthawed controls cores. The temperatures at 4 different depths in the core were recorded continuously. Water and gas samples from 4 different depths in the cores were collected weekly for pH, anions, cations, DIC, H2, CH4, CO, O2, N2O, N2 and CO2, and 13C of CO2 and CH4. At 0, 0.25, 6 and 12 months, sediment subsamples along 4 depths in sacrificed cores were collected for metagenomic analyzes. Total community genomic DNA (cgDNA) was isolated using FastDNA Spin Kit for Soil followed by Qiagen column purification. Shotgun metagenome libraries for samples before and after thawing were sequenced using 454 and illumina instruments and yielded >500 Gb of raw data. Taxonomic and functional characterization of the metagenomic sequences indicates specific microbial community gradients between the upper active layer and the lower permafrost layer. Differences in carbon cycling pathways between the upper and lower layers include aromatic ring oxidation and CO2 fixation potential in the uppermost layer and carbon reduction pathways in the permafrost layer. Potential CH4 cycling pathways primarily consist of methane oxidizers in the upper layer and there is a notable lack of potential CH4 producers in the lower layers. Nitrogen-cycling pathways also differ by depth with nitrogen fixation occurring in the upper layer and nitrification occurring in the permafrost layer. In addition to providing key information as to who the microbial members are and what their genetic capabilities are in the permafrost, these metagenomic sequences will provide the basis for overlaying the metatranscriptomic and metaproteomic data in order to understanding the relationships between competing cycling pathways.

# Microbial respiration regulation for enhanced In-situ remediation of complex contaminated sediment in Pearl River Delta

Mei-Ying Xu[1, 3*], Jin Liu[1, 3], Qin Zhang[1, 3], Chun-Yu Xia[1, 3], Zhi-Li He[2], Jun Guo[1, 3], Guo-Ping Sun[1, 3], Ji-Zhong Zhou[2], Yong-Ding Liu[4]

*[1]Guangdong Provincial Key Laboratory of Microbial Culture Collection and Application, Guangdong Institute of Microbiology, Guangzhou 510070, China;*
*[2]Institute for Environmental Genomics and Department of Botany and Microbiology, University of Oklahoma, Norman, OK 73019, USA;*
*[3]State Key Laboratory of Applied Microbiology (Ministry—Guangdong Province Jointly Breeding Base), South China, Guangzhou 510070, China;*
*[4]Institute of Hydrobiology, Chinese Academy of Sciences, Wuhan 430072, China*

With the rapid development of industry and urbanization, the aquatic system of Pearl River Delta is highly polluted. Complex pollutants including the highly persistent halogenated compounds polybrominated diphenyl ethers (PBDEs) and polycyclic aromatic hydrocarbons (PAHs), were detected in the aquatic sediments. As results, the aquatic sediments act as sinks of the internal loading of pollutants and delay the recovery of degraded aquatic ecosystems. In order to develop some strategies for accelerating the in-situ remediation process of the complex contaminated sediments, lab- and pilot-scale studies were conducted and metagenomic technologies combined with q-PCR, GC-MS and multivariate statistical analyses were used to evaluate the effects of several kinds of electron donors and acceptors on the microbial activities and the contaminant transformations in the sediments. The results indicated that the addition of electron acceptors could significantly stimulate the microbial functional gene diversities and abundances in the complex contaminated sediments, including those genes involved in C cycling, N cycling and S cycling, while the highest increases were observed when nitrate addition. No significant change was observed when adding electron donors. Meanwhile, higher removal efficiencies of total organic carbon (TOC), as well as PBDEs and PAHs, were detected after three months nitrate treatment when compared to the controls. These results suggest that nitrate injection can serve as a promising strategy to stimulate the indigenous microbial communities and enhance the remediation of complex contaminated sediments in Pearl River Delta.

# Phylogenetic Signals and Ecotoxicological Responses-A Case Study on Cadmium Susceptibility in Aquatic Insects

Ling-Tian Xie

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We used a phylogenetically based comparative approach to evaluate the potential for physiological studies to reveal patterns of diversity in traits related to susceptibility to an environmental stressor, the trace metal cadmium (Cd). Physiological traits related to Cd bioaccumulation, compartmentalization, and ultimately susceptibility were measured in 21 aquatic insect species representing the orders Ephemeroptera, Plecoptera, and Trichoptera. We mapped these experimentally derived physiological traits onto a phylogeny and quantified the tendency for related species to be similar (phylogenetic signal). All traits related to Cd bioaccumulation and susceptibility exhibited statistically significant phylogenetic signal, although the signal strength varied among traits. Conventional and phylogenetically based regression models were compared, revealing great variability within orders but consistent, strong differences among insect families. Uptake and elimination rate constants were positively correlated among species, but only when effects of body size and phylogeny were incorporated in the analysis. Together, uptake and elimination rates predicted dramatic Cd bioaccumulation differences among species that agreed with field-based measurements. We discovered a potential tradeoff between the ability to eliminate Cd and the ability to detoxify it across species, particularly mayflies. The best-fit regression models were driven by phylogenetic parameters (especially differences among families) rather than functional traits, suggesting that it may eventually be possible to predict a taxon's physiological performance based on its phylogenetic position, provided adequate physiological information is available for close relatives. There appears to be great potential for evolutionary physiological approaches to augment our understanding of insect responses to environmental stressors in nature.

# The fate and distribution of recently photosynthesized carbon in a maize-soil-microbial system under plastic film mulching and fertilizer application

Ting-Ting An[1], Shuang-Yi Li[1], Shi-Feng Fu[1], Jiu-Bo Pei[1], Hui Li[1], Jie Zhuang[2], Sean Schaeffer[2], Mark Radosevich[2], Jingkuan Wang[1*]

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Carbon isotopic labeling techniques can differentiate newly incorporated carbon that is fixed through plant photosynthesis from the native soil organic carbon. So the in-situ field $^{13}C$ pulse-labeling technique was used to trace the fate of $^{13}C$ in a maize-soil-microbial system and assess the effect of different mulching methods (with or without plastic film mulching) and three levels of organic manure fertilizer application (CK: no fertilizer control, M1: medium-level organic manure, and M2: high-level organic manure) on the dynamics of the photosynthetically fixed $^{13}C$ by maize planted in the long-term Brown Earth Experiment Station in Shenyang, Liaoning Province of China. The results show that the net photosynthesized carbon accounted for 64.01% of the added $^{13}C$ in the maize-soil system on the 1st day and then declined to 38.65% on the 15th day after labeling. The richest of $^{13}C$ abundance was measured in the control treatment without mulching. In this treatment the average $\delta^{13}C$ values in shoots and roots reached to 1567.76‰ and 598.00‰ after the 1st day, respectively, and 177.95‰ and 147.42‰ after the 15th day of labeling, respectively. The organic manure treatments with plastic film mulching had more photosynthetic fixed carbon, with averages of 558.82 mg $m^{-2}$ on the 1st day and 401.39 mg $m^{-2}$ on the 15th day, while a larger proportion was incorporated into below ground, with averages of 12.30% on 1st day and 15.66% on the 15th day compared with other treatments. The contributions of fixed $^{13}C$ in rhizosphere soil and bulk soil to microbial biomass carbon sharply declined from 76.90% and 65.45% on the 1st day to 22.44% and 20.07% on the 15th day, respectively. Organic manure treatments with plastic film mulching had the largest amount of microbial biomass carbon derived from photosynthesized carbon in all the treatments. All the results demonstrate that organic manure application coupled with film mulching facilitates the photosynthetized carbon fixation and enhances soil available organic carbon pools in plant-soil system during the maize seedling stage. The results could help to clarify the differences of carbon allocation to belowground and carbon utilization by soil microorganisms and then understand belowground carbon cycling under mulching and organic manure application.

**Key words**: Pulse-labeling; $^{13}C$ labeling; Organic manure application; Plastic film mulching; Microbial biomass carbon

# A Review of Water Beetle's Research in China

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Water beetles are one group of aquatic or semi-aquatic insects in Coleoptera, and most of them are gaining increasing recognition as indicators of water quality and water types. The studying history of water beetles in China was generalized and research progress including the latest advances in the taxonomy and fauna, phylogenetic relationship on species, genus and family level were introduced. In present, water beetles survey had got great achievement, and 23 families, 137 genera, 862 species in total were reported from China. Further more, some suggestions about water beetles' conservation of China were given.

**Key words:** Water beetles, studying history, survey, research progress, China

# Pyrosequencing Analysis of Bacterial Community during Alkaline Pretreatment of Excess Sludge

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The treatment of excess sludge is becoming a rising challenge for wastewater treatment due to numerous sludge production resulted from wide application of wastewater biotreatment. There are some disadvantages during the traditional anaerobic digestion, such as low efficiency and long sludge retention time [1]. One of the bottlenecks for resource utilization of excess sludge is hydrolysis process, and alkaline pretreatment has received more attention [2]. However little information is available on bacterial community during this process. In this study, 454 high-throughput sequencing technology was applied to analyzing the change of the bacterial community before and after sludge alkaline treatment at initial pH =12. The results showed that microbial community structure changed significantly after alkaline treatment and the 20 phyla, 58 classes, 98 orders, 169 families, 255 genera were obtained by 454 pyrosequencing. Among them, *Anaerolineaceae* and *Rhodocyclaceae* increased significantly and *Comamonadaceae*, *Chitinophagaceae*, *Flavobacteriaceae*, *Nannocystineae*, *Flavobacteriaceae*, *Caulobacteraceae*, *Bdellovibrionaceae* and *Acidimicrobiales* considerably decreased after 16 h alkaline treatment, which provided a basis on screening efficient bacteria for sludge hydrolysis under alkaline conditions.

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# Study on Biosorption of $Pb^{2+}$ with Rhodotorula mucilaginosa by Response Surface Methodology

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Biosorption could remove heavy metal ions such as $Pb^{2+}$ in solutions efficiently with less cost and no secondary pollution[1]. The biosorption of lead ions from aqueous solution on biosorbent of Rhodotorula mucilaginosa screened from a certain molybdenum ore tailing soil was studied. The optimization of $Pb^{2+}$ biosorption process was performed among three main independent parameters (initial lead ions concentrations, initial pH, and adsorption times) through a box-behnken design (BBD) under response surface methodology (RSM)[3]. The methods of SEM, EDX, and FT-IR were used to analyze the mechanism and characteristics of $Pb^{2+}$ biosorption on biomass surface. The SEM images of native and $Pb^{2+}$-adsorped R. mucilaginosa indicated that the original R. mucilaginosa biomass were integrated cells without transforming shapes or structure, whereas the micro-capsule outside cells were destructed and disappeared after adsorbing lead ions due to formed chemical bonds between lead ions and polysaccharide[3,4], furthermore EDX analysis of R. *mucilaginosa* showed that the existing of peaks of Pb at 2.3426 KeV after the biosorption of $Pb^{2+}$, which revealed that the biosorption of $Pb^{2+}$ on the R. mucilaginosa cells occurred indeed. The results of FT-IR test revealed that chemical interactions between the metal ions and the functional groups such as -OH, -C=O or C-O occurred on the biomass surface due to the changes of stretching vibration and bending vibration frequency for these groups, so the functional groups of -OH, -C=O, and C-O were mainly involved in the biosorption of $Pb^{2+}$ on R. mucilaginosa biosorbent. A total of seventeen experimental runs (five central points) were set to evaluate the interactions between the paired factors when other factor was kept at its optimal level and The quantitative relationship between the lean ions takeup (q) and different levels of three factors was used to work out optimal levels of these parameters. From three response surface plots involved these factors, it was disclosed that the biosorption capacity of $Pb^{2+}$ increased with increasing initial concentrations of $Pb^{2+}$ and adsorption times but it firstly increased and then decreased when the initial pH was rising. The optimum value of lead ions uptake of 1.45 mg/g biomass was achieved with RSM under design-expert software on the condition that the three parameters were 30 mg/l of initial $Pb^{2+}$ concentration, 5.45 of initial pH and 25 mins of adsorption time, respectively. The analysis of variance (ANOVA) of the quadratic model demonstrated that the model was highly significant. The fit of the model was checked by the determination of the value of the multiple correlation coefficient ($R^2$=0.9991), which indicated that this regression is statistically significant and only 0.9% of the total variations was not explained by the model. A relatively lower value of the coefficient of variance (CV=2.4%) obtained from design-expert software indicated the experiments were carried out more precisely and reliably and the optimization for the experimental parameters by response surface methodology provided a great boost for the commercial application of biosorption technology in the future.

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# The System Biological Characteristics of the Bioflocculant-Produing Strain A9

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Strain A9，which can produce bioflocculant with high flocculating activity , was screened from soil near one peach tree in China's Liaoning Province. It was a pale pink-pigmented, aerobic, Gram-positive, bioflocculant-produing bacterium. A bioflocculant, MBFA9, was produced from the strain A9 had a good flocculating capability and could achieve a flocculating rate of 99.6% for kaolin suspension at a dosage of only 0.1 mL/L[1]. Strain A9 was researched by using the multiphase classification tools (including morphological characteristics observation, physiological and biochemical characteristics experiment, DNA G+ C content test[2，3], DNA-DNA hybridization[4,5], Fatty acid composition[6]，16S rRNA sequence and phylogenetic position analysis). The taxonomic status of the strain A9 was determined by three levels, including phenotype, genotype and the phylogenetic development. The result showed that the G+C mol% of A9 was 51.9%. The DNA-DNA homologous hybridization rate between A9 and CGMCC 1.8907T was 51.6%. The dominant quinoid of A9 was MK-7, while the dominant fatty acids were anteiso-C15: 0, C16: 0, anteiso-C15: 0, iso-C15: 0 and C 18:1 ω7c. The main polar fatty acid were PG, DPG, PE and PI. In summary, based on its 16S rRNA gene sequence and these results above strain A9 should be a novel species of Paenibacillus.

The genome sequence of A9 was determined by Shanghai Majorbio Bio-pharm Technology Co., Ltd. (Shanghai, China), using Solexa paired-end sequencing technology [7]. A total of 4,387,020 paired-end reads (300-bp library) were generated to reach a 161.4-fold depth of coverage with Illumina/Solexa Genome Analyzer IIx (Illumina, SanDiego, CA). Open reading frames (ORFs) were identified by using Glimmer. All predicted ORFs were then annotated by BLAST and KEGG.

There were a total of 4,284 putative open reading frames (with an average size of 1113 bp) according to Glimmer. The obtained genome sequence of A9 consists of 92 contigs of 5,489,018 bp and had an average G_C content of 46.55%. The draft genome (about 4 Mbp) contains 92 contigs, which can be assembled into 47 scaffolds. Scaffold N50 was 203,315 bp. Automatic gene annotation was carried out by the NCBI Prokaryotic Genomes Automatic Annotation Pipeline (PGAAP) (http://www.ncbi.nlm.nih.gov/genomes/static/Pipeline.htmL), which was followed by manual editing. A total of 1,689 proteins were assigned to cluster of orthologous groups (COG) families. Fifty-seven tRNA genes for 19 amino acids (lack of Asp) and one 16S-23S-5S rRNA operon were identified. The proteins associated with carbohydrate transport and metabolism (COG initial, G)were the most abundant group of COG (209 open reading frames [ORFs], 12.4%), followed by those associated with amino acid transport and metabolism (E; 168 ORFs,10.0%) and transcription (K; 145 ORFs,8.6%). The A9 genome sequence and its curated annotation are important assets to better understand the physiology and metabolic potential of Paenibacillus sp. and will open up new opportunities in the functional genomics of this species.

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# Biological Leaching of Heavy Metals from Contaminated Sediments by Aspergillus niger

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Bioleaching of heavy metals from contaminated sediment using *Aspergillus niger* was investigated. Batch experiments were performed to compare leaching efficiencies of heavy metals and PAHs and to determine the transformation of heavy metal fractions and the ecotoxicological changes of the earthworm and wheat before and after bioleaching. The results showed that two-step process had higher leaching efficiencies of heavy metals than one-step process. When the mass ratio of soil to culture medium containing *Aspergillus niger* was 5% (w/v), 93.5% Cd, 62.3% Cu, 11.4% Pb and 57.2% Zn were leached in one-step bioleaching. While in two-step bioleaching, the highest metal extraction efficiencies of Cd, Cu, Pb and Zn were 99.6%, 71.9%, 65.4% and 56.4%, respectively. Only a small amount of Cu and Zn (Cu 1.8% and Zn 1.4%) were extracted in the control experiment. For both one-step and two-step bioleach-ing, the bioleaching efficiency of heavy metals was in a decreasing order Cd > Zn ≈ Cu > Pb. The results of the sequential extraction showed that the metals remaining in the sediment were mainly bonded in stable fractions after bioleaching. And average decrease rate of PAHs was 54% in two-step process, meanwhile low molecular weights and 3-,4-benzene rings PAHs had greater decrease rate of 73%. Leaching loss of N and P were 9.66% and 6.10%, lower than bioleaching by sulfur-oxidizing bacteria. The results of Scanning Electron Microscopy (SEM) images, Three-Dimensional Excitation and Emission Matrix (EEM ) Fluorescence Spectroscopy and Infrared Spectroscopy (IR) showed that during bioleaching process, the extracellular polymeric substances and organic matter of the sediment were leached out. The Ecotoxicological responses of the earthworm were Original bioleaching＞ One-step bioleaching＞Two-step bioleaching, and Ecotoxicity on Wheat ( *Triticum aestivum*) were Original bioleaching＞ One-step bioleaching＞ Two-step bioleaching, with Root elongation＞Shoot elongation＞ Germination rate＞ Weight. The extracted metals in TCLP test of the bioleached sediment by *Aspergillus niger* were under the regulated levels in China.

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# Study on Ecological Function Regionalization In Dandong

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With the analysis of natural, ecological and environmental characteristics of Dandong，and according to the national ecological function zoning planning and the relevant requirements of the ecological function zoning, a set of zoning indicators are formed. The main methods used to zoning the study region were field survey, spatial overlaying of various scenarios and interview. The ecological zoning of the study region was made on 2 levels, which are 5 ecological zones and 12 ecological function zones.

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# Adsorption Kinetics, Thermodynamics and Isotherm of Thiacalix[4]arene-Loaded Resin to Heavy Metal Ions

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Removal of heavy metal ions from wastewater and drinking water is of great importance due to their high toxicity. Adsorption has been proved to be one of the most feasible, simple, easily implemented and highly efficient methods for the removal of heavy metal ions from polluted water. Up to now, all kinds of novel adsorbents have been prepared and used to remove those heavy metal ions which are harmful to human health from wastewater or drinking water, such as tree materials, agricultural wastes, fly ash, modified clay materials, chelating resins and biological-based materials, etc. The thiacalix[4]arenas as one kind of important receptor compounds have attracted much attention of scientists from all over world. The thiacalix[4]arenes have outstanding selective complexing abilities to heavy metal ions by the cooperative coordination of the bridging sulfur atom and two adjacent phenoxide $O^-$ groups, and have no interaction with alkali metal ions and alkaline earth metal ions, such as $Na^+$, $K^+$, $Ca^{2+}$ and $Mg^{2+}$, etc. The immobilization of thiacalix[4]arenes onto a proper carrier could lead to an excellent selective adsorbent or sensor for heavy metal ions. Here, a thiacalix[4]arene-loaded resin was prepared and characterized. The adsorption capacities of the thiacalix[4]arene-loaded resin toward $Cu^{2+}$, $Pb^{2+}$ and $Cd^{2+}$ ions were investigated by batch adsorption experiments. It was found that the selective adsorption capacities of the thiacalix[4]arene-loaded resin are mainly attributed to the complex of the loaded thiacalix[4]arene with heavy metal ions. Various factors affecting the adsorption capacities such as contact time, temperature, pH and initial concentration of the metal ions were investigated. The adsorption kinetics was evaluated with the pseudo-first-order and pseudo-second-order models. The equilibrium data were analyzed using Langmuir and Freundlich isotherm models by non-linear regression. The adsorption kinetics followed the pseudo-second-order rate law for the three heavy metal ions, indicating chemical sorption as the rate-limiting step of the adsorption mechanism. The adsorption of heavy metal ions onto the thiacalix[4]arene-loaded resin is fitted better to the Langmuir isotherm than to the Freundlich isotherm, and the maximum adsorption capacities were 21.4, 47.9, and 44.9 mg/g for $Cu^{2+}$, $Pb^{2+}$ and $Cd^{2+}$ ions respectively. Thermodynamic studies revealed that the adsorptions of the thiacalix[4]arene-loaded resin to heavy metal ions were spontaneous and exothermic processes with an increase of entropy.

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# Research on technology integration of domestic sewage treatment in multi-cities of central Liaoning

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With the rapid development of new country construction, the environmental problem resulted from the domestic wastewater runoff has been the research focus. Although the wastewater volume discharged from single family is small, the effect is significantly serious due to the large number of rural areas, dispersed distribution and lag construction of infrastructure. This study reviewed the present treatment situation and restriction factors based on the analysis of wastewater quality and quantity. Comparing the conventional treatment methods, the research proposed the reasonable technologies for different positions and sewage volume. At the southwestern areas, anaerobic fermentation and hydrolysis acidification combined with subsurface wastewater infiltration method would be appropriate. On the other hand, in the northeastern area or the districts with higher requirement for nitrogen and phosphorus recharge, A/O followed by subsurface wastewater infiltration technology was recommended. At small and medium-sized towns located with relatively more numbers of industrial enterprises, CASS or $A^2/O$ method was suitable.

# Speciations of Heavy Metals in Soils and Phytoavailability in Wolongquan River Basin

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The paper studied potentially reactivity and phytoavailability of As, Cu, Pb, Zn, Cd, Cr, Hg with sequential extraction test and correlative analysis method in soils of Wolongquan river basin. The results indicated that different element has different reactivity and that same element coming from different sites has different reactivity, which are influenced by the components and characters of soil and the element nature and the level in soil. Available levels of As, Cu, Pb, Zn, Cd, Cr are positively correlative to the total levels of corresponding elements in soil while available Hg mostly is influenced by CEC and organic matter. moreover, available As mainly is affected by potential reactivity of As,CEC and clay grain;Cu, Pb, Zn, by potential reactivity level,pH,organic matter;Cr by potential available Cr, clay grain and organic matter in soil;Cd by potential available Cd and pH of soil. The phytoavailability of heavy metals in soils are related to the occurrences and the total of corresponding metal in soils, complex reciprocity of conmensal elements in soils and the character of soils. The As compound pollution in soil can increase phytoavailable Cu in soil. The higher levels of Pb,Cu in soil can accelerate the absorption of As from soil to plant. Different plants selecting absorb heavy metal,for example,leek is selecting absorbing Pb and Zn.

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# A DFT Study on the Heavy Metal Detecting Mechanism of a Novel TCAS-quantum Dot Fluorescence Probe

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Comparing with the traditional fluorescence dye materials, quantum dots owning unique and adjustable optical properties (such as wide excitation spectrum, narrow and adjustable emission spectrum and high optical chemistry stability)[1,2], are ideal fluorescence probe materials. Recently, the techniques of the preparation and application of quantum dots are developing rapidly, while the progress of theoretical research work is relatively slow, due to the huge and complex structure of quantum dots. This project is based on the Density Functional Theory calculation intended to modify the surface structure of CdE(E=S,Se,Te) quantum dots of different particle size with the third generation master material of molecular recognition-Thiacalix[4]arene, and according to the mechanism of fluorescence quenching sign of the novel micelle self-assembled TCAS probe, simulate novel fluorescence quantum dot probes. The effect of the structure, component, particle size and surface-modification on the electronic structure and luminescence properties will be studied and the response mechanism of the fluorescence quenching sigh will be discussed. We expect that our work in this project will provide new material structure of fluorescence probe and valuable theoretical reference for the technique of heavy metal pollution detecting.

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# Application of PCR-DGGE to Analyze Bacterial Community Structure for Subsurface Wastewater Infiltration System

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Subsurface wastewater infiltration system (SWIS) is an underground system for decentralized wastewater treatment in suburbs or rural areas. One of the most important components of the SWIS is the biomat, a layer of organic and inorganic material and microbes that forms at the interface between the NiiMi trench and the surrounding soil. To clarify bacterial community structure in the SWIS, two groups of modified SWISs, SWIS A filled with mixed substrates composed of 80 % meadow brown soil (MBS) and SWIS B with 80% MBS and 20 % sand, were constructed in the laboratory. Both of the SWIS worked stably in the intermittent operation mode including a flooding period of 12h and a drying period of 12h under the hydraulic loading of 8-10$m^3$ / ($m^2$d). The molecular technique of polymerase chain reaction coupled with denaturing gradient gel electrophoresis (PCR-DGGE) was used to determine bacterial species diversity and structure of microbial communities. Profile of PCR-DGGE showed spatial changes in the community structure and distributions in different layers. DNA diversity of bacteria around the distributing pipe was higher than that in other infiltration zones. Microbial number and diversity suggested that the functional microorganism distributions correlated to the different nutrient level in the SWIS. DGGE map and lane comparison results indicated that the difference was not remarkable between the two microbial community structures in SWIS A and B. And the hierarchical cluster analysis showed the genetic affinity between the microorganisms in deferent substrates.

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# Relationships between Landscape spatial characteristics and Surface Water Quality indices in a subtropical watershed ecosystem

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Human activities affect serious the surface water quality by changing the landscape composition and pattern of watershed in recent. It is important to know how landscape heterogeneity influences the water quality for environmental improvement. Based on the land use data in 2009 and the water quality variables in 27 sub-watersheds, we performed a study to explore the relationship between land use and water quality in a subtropical watershed named Liu Xihe watershed, south China. Results showed that the landscape pattern and water quality have significant correlation. The land for residential, traffic and cultivated exhibited a significant positive relation to all four water quality variables, and they were the main land use types as the pollution resource. The forest land negatively correlated with water quality variables in all riparian zones and sub-watersheds. The orchards only positively correlated with NO3-N+NO2-N and the relationship was no significant. For landscape indices, PD, ED, IJI and SHDI were significant positive correlation with all water quality variables. On the contrary, LPI, AWMPFD, AI and CONTAG exhibited significant negative relations with all four water quality variables. Overall, the forest land in the riparian zones brought more impacts on water quality than sub-watershed, while the relationships between most of other landscape indices and water quality variables are much significant at the sub-watershed scale.

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# Cadmium Accumulation and Antioxidative Defenses in leaves of Zea Mays L.

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Cd toxicity causes oxidative stress, which can take place possibly by generating reactive oxygen species (ROS) such as superoxide radicals ($O_2^-$), singlet oxygen ($^1O_2$), hydrogen peroxide ($H_2O_2$) and hydroxyl radicals ($OH^\bullet$) [1]. These oxygen species cause lipid peroxidation, which reflected by increased melondialdehyde (MDA) concentration [2]. To scavenge ROS and avoid oxidative damage plants possess the antioxidative enzymes superoxide dismutase (SOD), catalase(CAT) and peroxidase(POD), glutathione peroxidase, ascorbate peroxidase and glutathione reductase, as well as nonenzyme antioxidants such as ascorbic acid and glutathione [3].Corn (Zea Mays L.) seedlings were in four cadmium (Cd) levels of 0-1mg/L in a hydroponic system to analyze the antioxidant enzyme system, Cd content in the shoots and roots and growth responces in the leaves of corn. There was a significant increase in malondialdehyde (MDA) concentration from Cd 0mg/L to 1mg/L, and peroxidase (POD) and catalase (CAT) activities in the leaves of corn subjected to 0-1mg/L Cd. However there was a significant decrease in superoxide dismutase (SOD) activities subjected to 0-1mg/L Cd. This indicated that Cd stress induced an oxidative stress response in corn seedlings, characterized by an accumulation of MDA, decrease in activities of SOD and increase in activities of POD and CAT. Root and leaf Cd contents of corn increased with their exposure Cd level, and the highest Cd concentration occurred in roots, followed by leaves.

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# Preparation of Silicalite-1 Membranes on Silica Tubes and Its Separation Performance for Low Alcohol/Water Mixture

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In the past decade, due to the potential applications of zeolite membranes in a wide range of industrial processes including gas separation, catalysis, pervaporation, and membrane reactors, great interest has been focused on the preparation of zeolite membranes on various supports, and significant progress in synthesis and characterization of zeolite membrane has been reported[1-5].

It is well known that poor reproducibility of zeolite membrane preparation is a commonly problem. For example, Van de Graaf et al. reported that only 4 out of 12 silicalite-1 membranes had an acceptable quality, and Nock et al. [4] reported that the reproducibility of MFI membranes (five times of Knudsen factor) was increased to 70%. In 2001, Lin et al. [2] synthesized high performance and high reproducible silicalite-1 membranes on mullite supports. Before this paper was published, to our knowledge, the flux of silicalite-1 membranes never exceeded 1.0 $kg/m^2h$ with separation factor above 60 towads EtOH/water mixture. These results further suggest that suitable support is an important factor to synthesize high performace silicalite-1 membranes.

An important potential application of silicalite-1 membranes is to extract organics from low concentration aqueous solutions [1], and this is the main goal of current work. However, in the case of liquid separation, such as extracting low content alcohols from water, the preferred adsorption of alcohol molecules onto the surface of silicalite-1 zeolite provides the primary separation selectivity. Nomura et al. [5] examined the transport phenomena of ethanol through intracrystalline and intercrystalline pathways of silicalite-1 membranes separately, and an intercrystalline–intracrystalline model (i–i model) was proposed. According to this model, they declared that ethanol was permselective from ethanol/water mixtures through intercrystalline pathways. Therefore, aiming at the pervaporation application of silicalite-1 membrane, it is expected that the selectivity could be increased by increasing the hydrophobicity of the membrane, and besides by decreasing the membrane thickness, the flux could be also increased by increasing the quantity of intercrystalline pathways.

Two-step in-situ hydrothermal synthesis was used to synthesize silicalite-1 membranes on the outside surface of porous silica tubes. Before each hydrothermal synthesis, the support tubes were filled with mixed solution (containing water and glycerol) or without solution-filling, and then sealed with two Teflon caps at both ends and placed vertically in a Teflon-lined autoclave. After the synthesis solution was added, the autoclaves were put in an air oven and aged at 333 K or 348 K for 12 h, and then the oven was increased to 453 K. Synthesis solutions were prepared by mixing sodium hydroxide, tetrapropylammonium bromide (TPABr), silica sol (26 wt% $SiO_2$), and deionized water at room temperature. The molar composition of synthesis solutions were $TPABr:Na_2O:SiO_2:H_2O=1:0.25:10:X$ (solution 1: X=800; solution 2: X=1000). The first crystallization with solution 1 was carried out for 22 or 14 h and the second crystallization with solution 2 was carried out for 10 h. After each synthesis, the silicalite-1 membranes and collected zeolite powers were washed with

deionized water, dried at 353 K overnight, and then the silicalite-1 membranes were calcined at 773 K for 12 h to remove the templates.

By using solution-filling method and silica tubes. high-performance siliclaite-1 membranes were successfully synthesized on silica tubes by this method. It was found that the average flux of the membranes synthesized with SF method can be improved by about 90% compared with that of the membranes without SF method whlile keeping higher separation factor. The composition of different porous supports, such as slica tubes and α-alumina tubes, on the separation performance of the as-synthesized silicalite-1 membranes was investigated. It was found that the separation performance of membranes synthesized on silica tubes were higher than that of membranes synthesized on α-alumina tubes, which suggested that silica tubes may be more suitable to synthesize high-performance silicalite-1 membranes. Pervaporationexperiments shows that the flux of silicalite membranes at 333 K were 2.63, 0.87, 0.24, and 0.20 $kg/m^2h$ towards Methanol/$H_2O$, Ethanol//$H_2O$, 2-propanol/$H_2O$, and 1-propanol/$H_2O$ mixtures, repectively, and the corresponding separation factors were 22, 69, 81, and159, respectively.

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# Bioflocculant Produced by Bacillus sp. BS-5 and Its Application in the Algae Lake Water Treatment

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A strain bacterium, named BS-5, isolated from the riverbed sludge, was found to secrete excellent bioflocculants which had the high and stable flocculating activity for kaolin clay suspension. The effects of culture conditions, including carbon and nitrogen sources, initial pH value of culture media, culture temperature and aeration rate on the strain BS-5's bioflocculant-producing and flocculating activity were investigated respectively. Then, the optimum culture conditions were confirmed (mass fraction): soluble starch 1%, $NaNO_3$ 0.3%, $K_2HPO_4$ 0.12%, $MgSO_4 \cdot 7H_2O$ 0.05%, KCl 0.05%. When the initial pH value of the medium was adjusted to 6.0, the bacteria cultured at 30℃, shaken at 150 rpm in a rotary shaker for 32 hours and the suspension of kaolin clay treated with 0.1 ml/L of MBFBS-5, the flocculating rate reached more than 97%. In order to study the practical application of MBFBS-5, the algae lake water was treated. The results show that, when combined MBFBS-5 with PAS, the removal rate of COD is the highest up to 69.3%, and at the same time the dosage of PAS can be reduced remarkably.

# For LMCIP 3th Round Public Participation

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In order to improve urban transportation, Liaoning Jinzhou, Panjin, Liaoyang, Benxi, Fushun and Dengta government make use of World Bank loan for the urban infrastructure reconstruction. The related construction projects are: road infrastructure construction and road reconstruction sub-project (RI), Grade II Road reconstruction and purchase of road maintenance facilities (RM), public transport sub-project (PT), traffic safety and management sub-project(TS), etc.

Coordinating with the departments of six project related cities, Shenyang University conducted the 3rd public survey.

The questionnaires show that the satisfaction degree is high for the built roads. Among the six cities, Jinzhou have the highest satisfaction rate, which is 86.8%, and only 0.2% are not much satisfied, and 0.8% are quite unsatisfied.

In comparison with the early second public participation survey，the results of the two surveys indicates that there is a great increase of public satisfaction for the RI for all of the six cities, which shows a very success of the sub-project for road infrastructure construction.

Shenyang University has come up with proposals in relation to the methods of launching public participation as well as the promotion of public participation
For the project phases such as primary planning of evaluation, middle stage of project implementation (engineering) and the final stage of completing, there is a need to collect the general information and perform assessment systematically. So that the public participation in form of abnormal state should be made. The project practice has shown that the combination of four forms, such as open discussion conference, focused group discussion, individual focused discussion and questionnaire answering, is an effective way to perform this abnormal state of public participation.

This abnormal state of public participation is usually finished in a relatively short period of time, with the features such as wide range of survey and large amount of messages treatment, as well as the high requirements of technology. This work has to be completed by the professional persons without interests involved in the project with relatively high costs.

The financial support is one of the preconditions smoothly to perform public participations. During the whole process of the public participation, either the printing materials, survey tables, handbooks, or focused discussion holding, hearings, onsite survey, as well as the related statistical analysis, etc., the support funds are needed in all cases to ensure the smooth operation of the public participations.

# Screen of Plant-micorognism Synergy Model for the remediation of the Petroleum Contaminated Soil in Shen-fu sewage irriation area

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In-situ bioremediation of the contaminated soils was carried out in Shen-fu sewage irrigation area (SIA) by adding the microbial agents and fertilizer. The microbial agents were composed of the microbes which dominated in the oil-contaminated soil in SIA and the effective oil-degrading microbes from Shandong University. The results were as follows: the highly effective oil-degrading microbes existed in the long-term oil-contaminated soil and the nutrients might be one of the key factors limiting their growth during the accumulation of the oil contaminants; The degradation of contaminants was related to the contaminant concentration in soil during in-situ bioremediation, and the best removal of oil matters was from the synergy treatments of corn and microbial agent in low oil-concentration soil and *Astragalus adsurgens* Pall and microbial agent in high oil-concentration soil. Therefore, the best model for in-situ bioremediation the oil contaminated soil would beplant *Astragalus adsurgens* Pall only or plant corn and add microbial agent of in Shenfu sewage irrigation area.

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# Impacts of pH and Electrolyte on Cadmium Desorption Characteristics in Contaminated Soil

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In this paper, two kinds of different pollution degree soils denoted as L1 and L2 were used as test soils. Desorption experiment was carried out to study the impacts of pH and electrolyte on desorption characteristics of cadmium (Cd) in soils. The results showed that the variation trends of Cd desorption rates with increase in pH were similar. In other words, it decreased as pH increased. In acidic region, desorption rate of heavy metal Cd decreased rapidly as pH increased. When pH = 4, Cd desorption rate was largest; in neutral and alkaline regions (pH = 7-10), desorption rate of heavy metal Cd decreased slowly as pH increases. Cd desorption behavior was closely related to type and concentration of electrolyte. Under the same concentration, Cd desorption capabilities of three electrolytes in soils L1 and L2 could be expressed in following order: $CaCl_2$> $Ca(NO_3)_2$> NaCl.

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# The Development of Green Transportation System in Urban Area

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The modern transportation system is one of the main factors leading to the air pollution in urban area due to the tendency of increasing private car diving. “Green transportation system” would be the solution for sustainable city.

In this paper, the typical problems within current transportation system in China will be discussed first. The possible strategies for the development of urban green transportation system will also be introduced respectively, especially bicycle system and walking system. The road planting and planting design plays a vital role in the transportation system and in the urban sustainable development. The construction of a sustainable city would be closed related to the development of green transportation system.

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# Metal Ions Removal from Acid Mine Drainage by Using Hydrothermally Modified Fly Ash

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Acid mine drainage ( AMD ) is an important environmental problem associated with both working and abandoned mining operations. By using low cost fly ash as raw material a hydrothermally modified fly ash zeolite sorbent was prepared, and the efficiency of this sorbent in removing metal ions from AMD was studied under conditions of different pH, sorbent dosage, and contact time. At pH 7, the removal rate of $Pb^{2+}$, $Zn^{2+}$, and $Cu^{2+}$ was 100%, 95.12%, and95.18%, respectively. The $Cu^{2+}$ removal was mainly under the actions of both adsorption and precipitation, while the removal of $Zn^{2+}$and $Pb^{2+}$ was mainly due to adsorption. The adsorption rate of $Pb^{2+}$, $Zn^{2+}$ and $Cu^{2+}$ increased with increasing sorbent dosage, and the optimal dosage for the removal of $Pb^{2+}$, $Zn^{2+}$ and $Cu^{2+}$ was 20, 25, and 35 g/ $L^{-1}$, respectively. When the contact time was 20, 40, and 45min for $Pb^{2+}$, $Zn^{2+}$, and $Cu^{2+}$, the removal rate of the metal ions was up to 94.12%, 95.12%, and 98.12% respectively. The co-existence of the three ions didn't promote but restrain their removal.

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# Degrading Dynamics of Nitrobenzene in Soils and River Sediment

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The nitrobenzene is an important chemical industry material, which is used widely in manufacture aniline, dye, TNT, soap, spice and so on. It is faint yellow, with bitter almond taste poisonous matter, and hardly to be biodegraded. However, the demand of nitrobenzene show ascendant trend with the chemical industry development, thus bring heavy contamination to the water with the effluence[1,2]. At present, the common technology in removal nitrobenzene from waste water includes physical chemistry methods, such as activated carbon adsorption, oxidation, extract, irradiation, and so on[3]. These methods are high cost, and tending to cause second pollution. Although biodegradation is regarded as an economical and efficacious purified method in the treatment of industry waste water and sewage, the high toxicity of nitrobenzene would limit its application. Therefore, it is significant to screen bacterium that can effectively degenerate nitrobenzene and inoculate it in the nitrobenzene wastewater process project[4].

The research objects were the soils along the river and river sediment of the fourth Liuhe river in Nanjing chemical industrial park. Degrading dynamics of nitrobenzene in soils and river sediment and its affecting factors were studied through soil sterilization, the control of temperature and initial concentration of nitrobenzene. The degradation rate of nitrobenzene in non-sterilized soils and river sediment was respectively 0.945-1.018 times and 0.901-1.038 times of that in sterilized soils and river sediment in 45 d. The degradation quality of nitrobenzene in soils and river sediment by microorganism was 0.008-0.031 and 0.019-0.049 $mg \cdot kg^{-1}$. The half-live in non-sterilized treatment was shorter than that in sterilized treatment. In the range of (10±1)℃-(30±1) ℃, the degradation of nitrobenzene was accelerated with temperature enhancing. At (30±1)℃, the residual quantity of nitrobenzene in soils and river sediment was 0.602 and 0.534 $mg \cdot kg^{-1}$, the residual quantity and the half-live were both smallest.

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# Bioaccumulation and Stress Responses of Cadmium by *Beta vulgaris var.cicla L.*

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Phytoremediation is an environmentally friendly in situ technique for cleaning up metal contaminated land[1,2,3]. Hyperaccumulators are the base of phytoextraction[4]. It is difficult to screen out ideal hyperaccumulators that can remediate soil contaminated with heavy metals effectively.

A pot experiment was conducted to investigate the characteristics of accumulating Cd by seven crops . The results showed that Cd in shoot of *Beta vulgaris var.cicla* L. was the highest among all plants, and Cd concentration in shoot of *Beta vulgaris var.cicla* L. was higher than that in root. Another pot experiment was arranged with various Cd concentrations to study cd accumulation, tolerance of *Beta vulgaris var.cicla* L. and accumulation by *Beta vulgaris var.cicla* L. and its potential for phytoremediation.Results showed that the average concentration of Cd in shoots of *Beta vulgaris var.cicla* L. in 20 mg/kg (Cd) treatment was more than the accepted critical concentration of 100 mg/kg. The both of enrichment coefficient(EC) and translocation factor(TF) were higher than 1． Moreover, compared with the control， the growth of *Beta vulgaris var.cicla* L. in the treatment of 20 mg/kg(Cd) was not inhibited. So, *Beta vulgaris var.cicla* L. was a cadmium hyperaccumulator and could be applied to phytoremediate Cd-contaminated soils.

Other experiments were arranged with various Cd concentrations in solution to study the relationship of cd and chlorophyll a, protein, and peroxidase(POD). Results suggested that Cd can destroyed chlorophyll a. On the contary, Cd in the solution can promote proteide combining and improve the antioxidase vigour. This indicated the content of chlorophyll a, proteide combining and hyperoxide enzyme vigour have accepted certain effect equally with the condition of Cd in the culture solution.

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# Stusy on a New Type of Glass Ceramic Coating and PM Catalytic

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Because of easy to prepare, high catalytic efficiency and good resistance with sulfur, alkali metal catalyst has been considered as nice PM oxidation catalyst. However, the stability of the catalyst and the catalytic activity would deteriorate because the loss of catalytically active component K in the diesel exhaust environment[1]. Recently, the most popular method is bonding $K^+$ in the crystal lattice to inhibit the loss of K. But on the other hand, this could also restrain its high mobility, and depress the catalytic activity of PM. In contrary, the glass state catalytic ceramic coating could release K slowly and produce new active sites[2]. In the same time, the loss of K could be restrained by Al substitute. There are few reports about improving the catalyst activity of this kind catalyst. This project adopts sol-gel method to design a new kind of glassy ceramic coating which contains K catalysis and establish a new synthesis method to prepare it [3,4]. The research is focused on the catalytic activity and high temperature stability of the novel catalytic coating. Study on the effect of substitution of K and Al on the catalytic activity of PM oxidation. Clarify the physical laws of K losing inhibited by the substitution of K and Al. In order to provide new catalyst materials, methods and theories for diesel exhaust PM pollution control.

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# Phytoremediation of Cadmium-Contaminated Farmland Soil by the Hyperaccumulator Beta vulgaris L. var. cicla L.

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Heavy metal-contaminated soil caused by various human activities is one of the widespread global problems. The clean up of heavy metal-contaminated soils is necessary but difficult for their potential toxicity and high persistence. Phytoremediation is an environment-friendly and cost-effective green remediation technology using the hyperaccumulator or accumulator to remove toxic pollutants from soil and presents a promising alternative to current environmental methodologies especially for the large field application at low to moderate concentration of contaminants. The phytoremediation efficiency depends on the heavy metal contents in the plant and the biomass production. Therefore, large biomass and high accumulating capacity of plant used work well in the phytoremediation practice. Until now, among the limited Cd hyperaccumulators *Solanum nigrum L.*, *Salix'calodendron'* , *Populus spp*, and *Arabis paniculata*, may be good candidates for field conditions due to their potentially higher biomass. In order to enhance the Cd removal efficiency of these hyperaccumulators, some natural or synthetic chelators such as EDTA, NTA, DTPA, EDDHA have been studied and suggested for field application. However, applications of chelators in field conditions may result in secondary pollution of soils and potential risk of groundwater contamination. Therefore, suitable agronomic practices to maximize biomass of hyperaccumulators in field conditions may be a safe and ideal phytoextraction strengthening method.

In this study the Beta vulgaris L. var.cicla L., previously proved to be a Cd-hyperaccumulator by pot experiment, was investigated to verify its viability as an alternative in the Cd phytoremediation practice during one growing season (about two months) on farmland in Zhangshi Irrigation Area (SZIA), the representative wastewater irrigation area in China. In addition, the effects of planting density, and the amendment of chicken manure the most commonly used fertilizer in agricultural production in China on the phytoremediation efficiency were also investigated. Results showed that Beta vulgaris L. var. cicla L. is a promising plant in the phytoremediation of Cd contaminated farmland soil. The maximum of Cd phytremediation efficiency by Beta vulgaris L. var. cicla L. reached 144.6 g/ha during one growing season. Planting density had a significant effect on the plant biomass and the overall Cd phytoremediation efficiency ($p < 0.05$). The amendment of organic manure promoted the biomass increase of Beta vulgaris L. var. cicla L. ($p < 0.05$) but inhibited the Cd phytoremediation efficiency.

# Renewable Energy and Sustainable Development

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Energy plays an important role in the economic and social development and is an essential factor in overall efforts to achieve sustainable development, but it always cannot be sustainable utilized because of the negative consequences of the major energy use on the environment. Energy utilization and its major environmental impacts are discussed from the standpoint of sustainable development. Renewable energy technologies produce marketable energy by converting natural phenomena into useful energy forms and are the key to a clean energy future. Renewable energy technologies are identified as the most effective potential solutions to current environmental issues and realizing sustainable development. As a conclusion, renewable energy sources can have a beneficial impact on the following essential technical, environmental, economic, and political issues of the world, more use of renewable energy is necessary for developing a sustainable society.

# Contents of heavy metal elements in soil of vegetable greenhouses and its effect on groundwater

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With the rapidly growth of greenhouse coverage area in Liaoning province，soil nutrient status in different facilities agricultural region were investigated for the healthy development of greenhouses. In allusion to the problems of environmental pollution brought about by traditional and irrigation, Greenhouse soil samples along with corresponding groundwater samples in Faku area, Shenyang city, Liaoning Province were collected. Then accumulated heavy metals in Facilities soil profile and its effects on the groundwater were analyzed for different facilities agricultural region. The results show that The average of organic fertilizer in soil is 2.46%, Nitrate nitrogen was 75.87 ~ 91.49 $mg.kg^{-1}$, available phosphorus was 22.30 ~ 28.95 $mg.kg^{-1}$,available potassium was 54.51 ~ 125.90 $mg.kg^{-1}$.Nitrate nitrogen, available phosphorus and available potassium were heavy cumulated in soil of greenhouse vegetable． With the planting age increasing， the cumulative intensity was the higher． The concentration of heavy metal pollution in the soil of facilities agricultural regions has been accumulated and obviously higher near to the soil quality standard of our country. The most important reason may be fertilization (compound fertilizer) lead to heavy metal pollution in soil. The concentration of Cd are close to 1 $mg.Kg^{-1}$ value, part of shallow groundwater in facilities agriculture irrigation, the heavy metal content and nutrient content are lower than the state groundwater environmental quality standards, the concentration of nitrate and nitrite content has higher than background value, In order to effectively reduce environmental risk, Reducing fertilizer and growing vegetable, which resistant to heavy metal pollution, should be suggested.

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# Study on Treatment of Bathing Wastewater with Modified Chitosan Combining PAC

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Natural polymer flocculants chitosan have material-abundant， nonpoisonous， biodegradable ， low–priced advantages ,many scholars have paid attention to them. Research and application of natural polymer flocculants chitosan and ramification on wastewater treatment are reviewed in recent year[1,2].

In this paper， bathing wastewater was treated with graft copolymerization of chitosan and acrylamide that is called modified chitosan combining inorganic flocculent PAC. It not only improve on effect for treating of bathing wastewater with chitosan, but also overcome using limit of chitosan and other chemic flocculating agent in treating of bathing wastewater. It make the possibility of innoxious and safe chitosan' application in treating bathing wastewater for regeneration and recycling.

Flocculating effect on treatment bathing wastewater was compared with graft copolymerization of chitosan and acrylamide that is called modified chitosan, chitosan and inorganic flocculent. The results indicate that modified chitosan with less amount of chitosan had better flocculating properties than chitosan. Treatment bathing wastewater with modified chitosan combining polymeric aluminum chloride was primarily chosen and the experimental research was conducted. The experimental results showed that, modified chitosan combining polymeric aluminum chloride had better removal effect for organic matter in treatment bathing wastewater, and removal rate for Nephelometric Turbidity Units(NTU), 254nm Ultraviolet Absorbency(UV254) and Chemical Oxygen Demand(CODCr) was respectively 13%, 30% and 43% higher than with solely using polymeric aluminum chloride, and removal rate for Nephelometric Turbidity Units(NTU) and 254nm Ultraviolet Absorbency(UV254) was respectively 11% and 32% promoted with reduction of in half amount of solely using modified chitosan in treatment bathing wastewater. Under the optimum conditions of concentration of modified chitosan 2mg/L and polymeric aluminum chloride 30mg/L, pH neutral and temperature 30℃, bathing wastewater treated with enhanced coagulation treatment has showed that important water quality indexes is Nephelometric Turbidity Units(NTU)≤5, and Chemical Oxygen Demand(CODCr) ≤35 mg/L, 254nm Ultraviolet Absorbency(UV254)≤0.090cm, Anionic Surfactant≤1mg/L.It is the possibility of regeneration and recycling about treated bathing wastewater.

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# Alterations of Organic Acids in Phytoextraction of Cd and Pb by *Helianthus annuus L.*

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Heavy metals form the main group of inorganic contaminants and the recovery of sites contaminated with such compounds is one of the major challenges for environmental institutions [1]. Conventional cleanup technologies, including chemical or physical treatments, are generally too costly, and often harmful to desirable soil properties (i.e., texture, organic matter) for the restoration of contaminated sites [2]. More recently, phytoremediation is widely applied as a low cost and ecologically-responsible alternative to the expensive physical-chemical methods [3]. Sunflower (Helianthus annuus L.) has been considered as a candidate for bioaccumulation of heavy metals. In the present study, sunflower was used to enrich the cadmium and lead in sand culture. Three organic acids, Cd and Pb phytoextraction, and pH were investigated during 90 days. Results showed that contents of malic acid, acetic acid and succinic acid in cultures were dissimilar when exposed to different Cd and Pb concentrations. At the $90^{th}$ day, the amount of malic acid and acetic acid in Cd10 treatments was the highest (621.00 mg•$L^{-1}$, 440 mg•$L^{-1}$, respectively); succinic acids in Pb treatments were more than those in Cd treatments. In the complex of Cd and Pb treatments, malic acids and succinic acids contents in Cd10+Pb100 were higher than the others (473.50 mg•$L^{-1}$, 255.20 mg•$L^{-1}$, respectively); there were no acetic acids detected in Cd10+Pb50, Cd10+Pb100, Cd10+Pb400, and no succinic acids were found in Cd10 and Cd40+Pb50 treatments. Besides, the Cd/Pb contents in sunflower showed distinct correlations with pH and some organic acids, the reason might be that the Cd/Pb existence influenced the organic acids secretion in rhizosphere of sunflower, and the changes of organic acids alter the bioavailability of Cd and Pb in cultures conversely. Sunflower showed distinct ability accumulation of Cd and Pb in sand culture, which might be due to physiological characteristics of sunflower and species or concentrations of metals. The secretion of some organic acids was affected by Cd or Pb; meanwhile, changes of acidity in cultures owing to organic acids might influence the bioavailability and bioaccumulation of toxic metals.

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# Microorganism agent Enhanced Phytoremediation of PAHs Contaminated farmland soil

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Phytoremediation is defined as the use of green plants to remove pollutants from the environment to render them harmless. It is an *in-situ*, solar energy regulated technique, which minimizes environmental disturbance and reduces costs..[1] Several species of grasses such as Bouteloua gracilis, Elymus Canadensis, are known to degrade PAHs. However, due to the low bioavailability of PAHs in soils, the efficiency of phytoremediation is relatively low. To enhance the effectiveness of phytoremediation, researchers take many strengthening measures, such as intercropping cultivation of plants; mycorrhizal fungi enhanced rhizosphere, also played an efficient effect. [2] As a novel microbial remediation technique, the immobilized microorganism agent is attracting more and more attention to restore organic contaminated soil.

An immobilized microorganism is defined as a microbe that prevented from moving independently of its neighbors to all parts of the aqueous phase of the system by natural or artificial means. [3] The immobilized microorganism technology offer a multitude of advantages in contaminated soil treatment, for instance, higher biomass loading, higher microbe retention time, easier operation , higher biodegradation rates, higher metabolic activity and better operation stability.[4]

A pot experiment was carried out in greenhouse to investigate the effect of different concentration of immobilized microorganism agent to the ryegrass system. The aim is to find a feasible approach of PAHs contaminated soils and provide a reference to the in situ phytoremediation.

The microorganism agent contained PAHs degrading bacterial and fungal which was adsorbed onto the carriers. Its moisture was content of 50% to 60% and the amount of bacteria and fungal were $5\times10^{19}$~$1.5\times10^{20}$ cfu·g$^{-1}$(dry agent) and the amount of fungal of $1\times10^{7}$~$3\times10^{7}$ (dry agent) respectively.

Concentration of PAHs in variously treated soils after 60 days are showed in Table1. The residual concentration after phytoremediation by ryegrass was 2825μg·kg$^{-1}$, which is decreased 23.5% comparing initially contaminated soil, and the low ring PAHs (2,3,4 ring PAHs) were higher removal rate, most single kind of PAHs can be removed more than 21%, while the average removal rate of high ring PAHs was only 12.5%.

The residual concentration of PAHs was decreased further with the use of the microorganism agent. With the addition of microbial agents, the removal rates of PAHs reached 38.6%, 42.2% and 44.3%, compared with the control , significantly improved ($P < 0.05$), increased to 64.3 ~ 88.5%. Use of microorganism agents can enforce PAHs dissipation effect in the plant system, and more effective to high molecular weight PAHs, which removal rate was twice than the plant treated.

Table 1 PAHs concentration of different treatments in soils (μg·kg-1 soil)

| Treatment | Initial concentration | Residual concentration | | | |
|---|---|---|---|---|---|
| | | M0 | M1 | M2 | M3 |

| | | | | | |
|---|---|---|---|---|---|
| Flu | 43±6 a | 22±4b | 25±5c | 26±2c | 42±8d |
| Phe | 521±42 a | 384±65b | 278±41c | 267±52c | 209±23d |
| Ant | 75±16 a | 37±8b | 41±11ab | 47±6ab | 40±12ab |
| Fla | 295±18 a | 191±42ab | 192±13bc | 173±18bc | 154±20 d |
| Pyr | 581±57 a | 365±32b | 247±24c | 235±44c | 272±29abc |
| BaA | 99±17 a | 64±10ab | 61±7ab | 48±7abc | 41±5abc |
| Chr | 596±58 a | 470±34b | 330±33ab | 281±34ab | 258±31abc |
| BbF | 384±77 a | 335±23b | 281±24ab | 285±22ab | 281±33ab |
| BkF | 138±18 a | 116±11b | 92±8ab | 71±7ab | 62±9abc |
| BaP | 131±12 a | 81±12b | 66±4ab | 80±9b | 73±10ab |
| DaA | 40±9 a | 41±6a | 30±7 a | 29±10ab | 34±5a |
| BgP | 512±47 a | 64±32a | 390±11ab | 411±26ab | 401±32ab |
| Icp | 245±22 a | 23±19a | 215±22ab | 210±16ab | 216±14ab |
| Total | 3659±187a | 28251±12 | 2257±114 | 2163±145 | 2079±187c |

M0：control treatment, M1-M3: 10g·kg$^{-1}$ , 20g·kg$^{-1}$ , 40g·kg$^{-1}$microorganism agent

The number of bacteria and fungus is $9.3\times10^{8}$ cfu·g$^{-1}$and$1.2\times10^{4}$ cfu·g$^{-1}$ in the soil of plant treatment. With the use of microorganism agent, the number of bacteria is increased 3-6 orders of magnitude and the number of fungus is increased 3-25 times. The microorganism agent was applied to the soil with the form of immobilized, so the microbe can gradually adapt to environment condition and reproduce. At the same time, micro-ecological environment could be formed in plant rhizosphere, which was benefit for the degradation of PAHs.

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# Decomposition Analysis of Energy Ecological Footprint: A Case Study of Bohai Rim Region

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Energy ecological footprint (EEF), accounting for a significant proportion of ecological footprint, is the most important factor of impacting the ecological pressures [1]. The world footprint of energy consumption in 2003 accounted for a half of the total ecological footprint reported by "Living Planet Report 2006" [2], which was more than 10 times in 1961. The study by Chen *et al* [3] reported that China's energy footprint rapidly increased in the past 53 years and almost doubled one time in the recent 10 years. Human energy consumption depended on many factors such as the social, economic, technological, production, daily life demands, which determined the size of the energy footprint. The identity of the key factors controlling the energy footprint growth to provide ways to reduce the ecological pressures is the concern of researchers [4]. Bohai Rim Region, one of three major economic circles in China, has a larger population, bigger GDP and higher energy consumption. This study aims to research the changes of the energy footprint from 2000 to 2008 in the Bohai Rim Region, analysis the energy footprint and identify the main impact, using the ecological footprint and decomposition model.

The per capita energy footprints of BoHai Rim Region from 2000 to 2008 were calculated with the method of carbon sequestration as the forest area absorbing carbon dioxide released by per unit consumption of fossil energy, referring to the study by Chen *et al* [3]. Decomposition analysis model is based on the input-output technology, Logarithmic Mean Weight Divisia Index (LMDI), improved by Ang *et al* [5] in 1998. The total amount of energy footprint (I) can be showed as the function of regional population (P), the level of economic development (A) and the level of ecological economic technology (T): $I = f(P, A, T)$. Where, $T$ equals the product of energy strength ($T_1$) and the coefficient of energy structure ($T_2$), so the IPAT model can be rewritten as $I = P \times A \times T_1 \times T_2$. The total energy footprint variation ($\Delta I$) and the change rate ($D$) at the $t$ time compared with that at 0 time are calculated as $\Delta I = I^t - I^0 = \Delta I_P + \Delta I_A + \Delta I_{T1} + \Delta I_{T2} + \Delta I_{rsd}$ and $D = I_t / I_0 = D_P D_A D_{T1} D_{T2} D_{rsd}$. Where, $\Delta_{Irsd}$ and $D_{rsd}$ are decomposition remnant. Factor decomposition is calculated as follow:

$$\Delta I_P = \sum_i W_i' \ln \frac{P_i^t}{P_i^0}, \quad \Delta I_A = \sum_i W_i' \ln \frac{A_i^t}{A_i^0}, \quad \Delta I_{T_1} = \sum_i W_i' \ln \frac{T_{1i}^t}{T_{1i}^0}, \quad \Delta I_{T_2} = \sum_i W_i' \ln \frac{T_{2i}^t}{T_{2i}^0};$$

$$D_p = \exp(W \Delta I_p), \quad D_A = \exp(W \Delta I_A), \quad D_{T_1} = \exp(W \Delta I_{T_1}), \quad D_{T_2} = \exp(W \Delta I_{T_2}).$$

Where, $W_i' = \frac{I_i^t - I_i^0}{\ln(I_i^t / I_i^0)}$, $W = \frac{\ln I^t - \ln I^0}{I^t - I^0}$, $\Delta_{Irsd} = 0$, $D_{rsd} = 1$.

In Bohai Rim Region, per capita ecological footprint was from 1.936 $hm^2$ to 2.984 $hm^2$ during 2000-2008, of which, 50-60 percent was attributed to energy consumption. The value of EEF was 0.974 $hm^2$ in 2000 and increased to 1.946 $hm^2$ in 2008. Of total EEF, more than 99 percent was caused by fossil fuel combusting. The energy consumption strength continuously reduced from 2000 to 2008. This showed an improving of energy utilization efficiency in economic system. However, the improving was not enough to counteract the ecological impact derived from immoderate energy structure and consumption level, which leaded to an increase of

EEF in Bohai Rim Region. Of all decomposing factors, the economic factor was most important for EEF, and energy structure and population were posterior. This indicated that fast increasing scale of economy had already been a main factor leading to ecological pressures. Though the decreasing of energy consume strength counteracted the ecological pressures in part, it was still increasing for other factors. The correlation analysis showed that total effect of all decomposing factors was significantly related to population, economy and energy consume strength, with the Pearson coefficient of 0.94, 0.95 and -0.98, respectively ($P$<0.01). It suggested that under the development of economy, improving energy utilization efficiency and generalizing green consumption was a main approach to reduce the ecological pressures from energy consumption.

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# The Present Status of Environmental Pollution and Research Progress of Pharmaceuticals and Personal Care Products (PPCPs) in China

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With the large scale development of pharmaceutical and cosmetic industries, the amount of production and use of pharmaceuticals and personal care products (PPCPs) are remarkably increased, resulting in the PPCPs remaining and polluting water, soil and air environment. However, during the last decades, PPCPs have not drawn adequate attention in China. For its wide distribution, complicated composition, strong ecological toxicity, it has become one of the research focuses in China now. Based on the sum-up of published literatures, this paper analyzed the main source of PPCPs and pollution situation in China. Finally, the technologies for PPCPs degradation were discussed. Now, the researches on PPCPs mainly focus on analytical methods and investigations into the pollution level of PPCPs. The fate of PPCPs in the environment, ecology and health risks and pollution control technology of PPCPs should also be improved.

# Experimental Research for Ecological Protection Techniques of Riparian zones in Liaohe River

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Soil bioengineering is a means to assess and improve living vegetation systems, to repair the damage caused by water erosion and to protect riverbank ecosystem integrality[1,2]. In the present study, a section of Liaohe River in east of Shuangan bridge Yingzhou District, Tieling was selected as an example to study ecological slope protection technique of riverbank in an agricultural catchment. In order to assess the potential of the slope protection project, the length of taproot, height of branches, and base diameter of shoot were determined. The results showed that the *Salix suchowensis* species is growing very well with strong root system and flourished branches, which can help control soil erosion effectively. Furthermore, the growth indexes of *Salix suchowensis* were higher than those of other shrub species after five months growing. Along with the riverbank being reinforced by soil bioengineering technique, native plants have been in rapid restoration and biodiversity increases.

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# Detection of Wheat Dwarf Virus (WDV) in Wheat and Vector Leafhopper (Psammotettix alienus Dahlb.) by Real-Time PCR

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Wheat dwarf virus (WDV), a member of the genus Mastrevirus, causes wheat dwarf disease, one of the most serious wheat diseases in Europe, Asia and Africa. Wheat dwarf virus (WDV) is a newly emerging pathogen affecting wheat production in China. A real-time PCR method using the TaqMan probe is described for quantitative detection of WDV in wheat tissues and in leafhopper (Psammotettix alienus Dahlb.). Primers and probes for specific detection of WDV were designed within the conserved region of the coat protein (CP) gene sequence. The primer–probe combination was designed: WDV-F: 5┘ -CCC CGG GTC GAT CTG ATT-3┘ (upstream), WDV-T: 5┘ -CCT GTT TTG CTC AGG GTA AGG CCG AT-3┘ (TaqMan probe), and WDV-R: 5┘ -CGG TCT GAT TTG TAT GCC GAT T-3┘ (downstream) targeting the conserved region within the WDV CP gene (GenBank accession number EF536881). The TaqMan probes were labeled with 6-carboxyfluorescein (FAM, excitation wavelength 494 nm, emission wavelength 521 nm) at the 5┘ -end and Black Hole Dark Quencher 1 (BHQ-1) at the 3┘ -end. A sensitivity assay showed the detection limit of the assay was 30 copies, and the standard curve was linear over range 30–$3\times10^6$ copies, with good reproducibility. Simultaneously, this real-time PCR assay could be used to detect WDV CP genes in viruliferous leafhoppers. As determined by an end-point dilution comparison, real-time PCR was close to $10^4$-fold more sensitive than the indirect enzyme-linked immunosorbent assay for WDV detection. Field samples of wheat and leafhopper collected from different regions of China were detected by both real-time PCR and gel-based PCR. The results showed more positive samples could be identified by real-time PCR than by gel-based PCR. This quantitative detection assay provides a valuable tool for diagnosis and molecular studies of WDV biology.

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# Effects of Fertilization Combined with Urease/Nitrification Inhibitors on Nitrogen Transformation in a Soil-Plant System under Greenhouse Cultivation

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A field experiment was conducted to examine the effects of nitrogen fertilization combined with urease inhibitor N-(n-butyl) thiophosphoric triamide (NBPT) and nitrification inhibitor dyciandiamide (DCD) on nitrogen dynamics in a soil-cucumber system under greenhouse cultivation in Damintun town, Xinmin County of Northeast China. Soil and plant samples were collected throughout the growing period of cucumber, from March 24 to July 1. Results showed that with the same amount of urea N applied, both urease and nitrification inhibitor addition could increase soil $NH_4^+$-N and soil microbial biomass N concentrations throughout the growing stages, enhance soil $NO_3^-$-N and total available N concentrations in the late growing stages. Dyciandiamide addition could inhibit soil $NO_3^-$-N concentration in the early growing stages. Combination of NBPT and DCD could significantly inhibit nitrification of $NH_4^+$, especially in the early growing stages, indicating a synergistic effect of NBPT and DCD on slowing down nitrification, inhibiting $NH_4^+$ volatilization, and maintaining N as $NH_4^+$ form in soil. NBPT combined with DCD could significantly decrease the nitrate concentration in cucumber ($P$ <0.05). Cucumber yield was not significantly different among treatments, suggesting a possibility of reducing chemical fertilizer N input in greenhouse vegetable production systems.

# Study on Control Effect of Cabbage wilt and Fermentation Condition for Antagonist Bacteria P-161

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An antagonistic bacteria, named P-161 was separated from the vegetable garden soil and preliminary identified as *Bacillus subtilis*. Its biological controlling potential has been proved by preliminary tests. In this research, the antagonism of the strain, the controlling effect to the cabbage wilt disease, the identification of strain, fermentation medium screening, optimization of fermentation broth and the physical and chemical characteristics of the strain were studied. Dual-culture tests showed that, the bacteriostasis bands of the P-161 to the cabbage wilt and other 16 plant pathogen fungi were all obvious, from 6.6mm-12.5mm, which indicated that the P-161 had strong inhibiting effects to these pathogen fungi. The research proved that the inhibition of the P-161 to the wilt pathogen was mainly caused by competition and antagonism. Among the total, the most important was the P-161 inhibited the pathogen spores germination or caused the sporses abnormity through secreting some antagonist. The competition of the P-161 against the pathogen was obvious, it might play an important role in practice. The medial components and cultural conditions for antagonistic activity of P-161 were optimized by single factor and uniform tests in shake-flash. The optimal industrial fermentation culture medium was: indian meal 1.2g, bean cake powder 3.0g, $K_2HPO_4{\cdot}3H_2O$ 0.4g. The best fermentation condition of P-161 is: the seed was cultured for 21~24 hours, the pH of production medium was adjusted to 6.0 before sterilization, the fermentation was carried out in 500mL Erlenmeyer flask with 50mL production medium inoculated with 5% seed culture and incubated at 35℃, 180r/min for 60~66 hours.

# Stable Carbon and Nitrogen Isotopes Composition and Relationship between Different Trophic Levels in Arthropods of Smelting Areas

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By measuring the $\delta^{13}C/\delta^{15}N$ ratios of plants and their main consumers in different biotopes of smelting areas, the characteristics of different consumers, stable carbon and nitrogen isotopes composition and relationship between different consumers were studied. The results showed that the changes of $\delta^{13}C$ and $\delta^{15}N$ concentrations in arthropods were great, and the variation ranges were within the range from -12.61‰ to -29.63‰, from 1.73‰ to 9.94‰, respectively. The C3 plants were domainant, which led to the $\delta^{13}C$ value decrease in different biotopes animals. The $\delta^{15}N$ ratios of *Argiope bruennichii* and *Paraten odera sinensis* were higher than those of other animals. According to the trophic model, the primary consumers were herbivores (*L. migratoria manilensis*, *A. chinensis*, *Gryllidae*), which were the second trophic level. The third trophic level included *A. bruennichii* and *P. odera sinensis*, which were the secondary consumers.

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# Discussion on Sustainable Development of Municipal Ecological Environment in Northeastern CHINA

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Based on both cities in northeastern China and the theory of sustainable development, municipal ecological environment involving social economic activities, natural ecology, environmental protection and the relationship between them are discussed in this paper. In connection with serious problems of municipal ecological environment in northeastern China, several practical methods of municipal ecological environmental sustainable development are suggested.