Editorial

Jianlong Wang and Xiangliang Pan

Laboratory of Environmental Technology,
INET, Tsinghua University,
Beijing, 100084, China
E-mail: wangjl@tsinghua.edu.cn
E-mail: xiangliangpan@163.com

Biographical notes: Jianlong Wang is a Professor at the Tsinghua University. His research focuses on environmental biotechnology. He is particularly interested in the biological treatment of water and wastewater, biodegradation of toxic organic compounds and bioremediation of contaminated soil. His laboratory is engaged in studies of the interaction between microorganisms and heavy metals, the degradation of Persistent Organic Pollutants (POPs), the research and development of biosensor for rapid measurement of Biochemical Oxygen Demand (BOD), phytoremediation of radio-nuclides and heavy metals-contaminated soil, bacterial adaptive responses to organic and inorganic pollutants. He has published more than 200 papers in national and international journals.

Xiangliang Pan won his PhD in Environmental Sciences at the Graduate School of Chinese Academy of Sciences in 2003. He worked as a postdoctoral research fellow at Institute of Nuclear Energy Technology, Tsinghua University from 2003 to 2005. Now, he is a Professor at Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences. He also is a standing member of Water Environment Division of Chinese Associate of Environmental Sciences. Latest of works of him include bioremediation of contaminated environments, environmental toxicology and wastewater treatment. Over 30 papers were published at peer-reviewed academic journals.

Novel biological solutions to environmental problems are fast becoming available through the application of modern technologies and in-depth studies of specific natural systems. This special issue of *International Journal of Environment and Pollution* focuses on environmental biotechnology.

The past two decades have seen a revolution in environmental microbiology and microbial ecology, which leads to changes in our understanding of the complexity of microbial communities in the environment. It has made us reconsider many conventional approaches to environmental biotechnology.

What is environmental biotechnology? It can mean lots of things! What it means to any particular individual depends very much on their scientific background and also on the context of a particular investigation. Environmental biotechnology may include following contents: the horizontal gene transfer and delivery of novel pollutant-degrading capabilities to a microbial community, the complexities of microbial community composition and their response to the environment, the exploitation of the global gene pool as a resource for the search and discovery of novel bioactive compounds,

technological process applied for environmental benefit that relies on the activity of the biota present in a particular natural or engineered environment.

It was our intention when calling for papers for this special issue, to consider environmental biotechnology from some of these differing perspectives. As we said in the 'call for paper', environmental biotechnology is a discipline with an ever expanding horizon. Environmental biotechnology applies the principles of microbiology to improve environmental quality. Applications of environmental microbiology include preventing the discharge of pollutants to the environment, treatment of industrial and municipal wastewater, enhancement of the quality of drinking water, remediation of contaminated environments, and producing valuable materials for human beings. Therefore, we would like to call for papers addressing research on all aspects of environmental processes using microorganisms and higher plants.

Many molecular biological tools, such as PCR and FISH, have now become relatively routine for the analysis of microbial communities and are providing valuable new insights into structure–function relationships in microbial communities that are directly relevant to environmental biotechnology. Several papers have more explicit links with practical applications of environmental biotechnology. 'Detection of enteroviruses from water samples using optimised RT-PCR with universal primers', 'Rapid detection of pathogenic bacteria in surface water by PCR with universal primer', by Professor Wang Xiaochang and his colleagues, their excellent research works provide us a suitable and rapid method for detection of virus in water environment. 'Effect of flocculant on microbial populations and function in chem-bioflocculation (CBF) treatment process using PCR-DGGE method', by Professor Xia Siqing and his colleagues, and 'Real-time PCR quantification of ammonia-oxidising bacteria in aerobic granular sludge and activated sludge influenced by pentachlorophenol' by Professor Liu He and his colleagues, can help us further understand the biological communities in wastewater treatment systems. Their researches illustrate how molecular biological tools intelligently applied in an environmental context can elegantly provide insight into fundamental environmental processes.

Heavy metal pollution has become a serious environmental problem in recent years, especially in some areas of China. The application of biological technologies for the removal of metals from wastewater and contaminated soils has been receiving increasing attention. Several papers in this special issue reflect significant progress in this area. Phytoremediation has been proposed as a promising green technology for the remediation of heavy metal contaminated sites. Profesor Qiu Rongliang and his colleagues have done the research in this field for several years. Their papers 'Zn and Cd hyperaccumulating characteristics of *Picris divaricata Vant*' reported a new Zn and Cd hyperaccumulator found in Lanping Pb/Zn mining area, China, which provides a new material for the study on the uptake, translocation and detoxification mechanisms of hyperaccumulators in combined heavy metal polluted soils. Professor Guo Zhaohui and his colleagues reported the Growth response and tolerance of Job's tears (*Coix lacryma-jobi* L) to arsenic in the spiked soils. They concluded that this plant is potential for the restoration of arsenic contaminated soils. Biosorption is a process that utilises inexpensive biomass to sequester toxic heavy metals and is particularly useful for the removal of contaminants from industrial effluents. Dr. Xiangliang Pan's papers 'Biosorption of strontium ion by immobilised *Aspergillus niger*', 'Biosorption of thallium by dry biofilm biomass collected from a eutrophic lake', and the paper 'Mechanism and kinetics on Zn (II) removal from the wastewater by immobilised SRB sludge beads of inner cohesive

nutrient source' by Professor Chai Liyuan, suggested that microbial biomass is a potential adsorbent for removal of heavy metals from aqueous solution. Dr. Peng Hui et al also reported the biosorption of copper (II) and zinc(II) from aqueous solution by intact and pre-treated biomass of *Oscillatoria planctonica*, their results indicated that *Oscillatoria planctonica* was effective in removing Cu(II) and Zn(II) from wastewater.

Microbial transformation under anaerobic conditions has attracted less attention in biotechnological applications, because the speed of biotransformation is generally much slower than that under aerobic conditions. Anaerobic conditions are also important for methane fermentation, a process used to treat organic wastewater. Systems that operate under anaerobic conditions have advantages over conventional aerobic treatment systems, because the aerobic processes require more energy for aeration and produce larger amounts of excess sludge. In this special issue, there are several papers on the research and application of Anaerobic Baffled Reactor (ABR), one of the promising systems presently. There are several papers by a number of researchers, such as Professor Sun Jianhui, Dr. He Shijun and Professor Sun Delin.

Eutrophication is a serious concern in many lakes and bays, especially in China today. The papers by Professor Hou Wenhua, on the suitable phosphorus concentration level for restoration by duckweed, and on effects of environmental conditions on the phosphorus distribution of constructed duckweed (*Lemna minor*) microcosm, applied the isotope techniques to investigate the effect of environmental conditions on Phosphorus (P) distribution and different P fractions in sediments in constructed duckweed microcosms, indicated that restoration of eutrophicated lakes by means of duckweed could, to some extent, reduce the internal P loads of sediments. The paper by Professor Wu Weizhong, reported the isolation of a freshwater cyanophage (F1) capable of infecting *Anabaena flosaquae*, from water bloom samples of Dianchi Lake, a eutrophicated lake in Yunnan Province, PR China. Cyanophage is a type of double strain DNA virus that is infective to cyanobacteria, it is attractive agents for controlling blooms of cyanobacteia. Their research can contribute to the development and utilisation of biological bloom controlling technology.

Nitrate contamination of groundwater has become more and more serious in many countries, especially in China. Biodegradable Polymers (BDPs) in form of pellets can serve as biofilm carrier and simultaneously as water insoluble carbon source for heterotrophic denitrification, which is accessible only by microbial enzymatic attack. Several papers by Professor Wang Jianlong's research group, proposed a new type of denitrification, which could be called 'solid-phase denitrification', exhibits the great advantage in contrast to conventional treatment.

Common themes are found in the papers, one being the importance of the isolation and characterisation of novel microorganisms. Nature contains a broad spectrum of microorganisms, most of which have not yet been isolated or studied in any detail.

Thus, in order to broaden the range of application of microorganisms in environmental biotechnology, scientists are currently interested in isolating new microorganisms with novel characteristics – rather than in engineering already acquired microorganisms. The paper 'Treatment of landfill leachate by effective microorganisms' by Professor Qiu Zhongping, suggested a new idea for the treatment of wastes which contain nonbiodegradable organic compounds. The paper 'Degradability of *n*-hexadecane by *Bacillus cereus* DQ01 isolated from oil contaminated soil from Daqing oil field, China' by Professor Wang Hongqi and his colleagues, demonstrated that cytoplasmic and periplasmic enzymes of *Bacillus cereus* DQ01 were responsible for

degradation of *n*-hexadecane. Dr. Zhang Lizheng and her group reported the influence of environmental factors on the degradation of carbendazim, a widely used agricultural and horticultural fungicide, by *Bacillus pumilus* strain NY97-1, their results showed that this strain could be a potential bacterial resource for carbendazim biodegradation and might play an important role in bioremediation of carbendazim-contaminated environment.

Biotechnological research has generated significant scientific advances, led to solutions to problems for which remedies have been lacking. Clearly there is tremendous potential for biotechnological applications in the environment. It is predicted that the rapid advances in molecular biology and the increased emphasis on interdisciplinary approaches in studies of complex ecosystems will lead to a surge in interest and exploitation in environmental biotechnology.

Owing to the large number of excellent papers received for this Special Issue, it has been necessary to divide them between several issues of the journal. This issue is Part 1, Part 2 will be published in Volume 37 Nos. 2/3, Part 3 in Volume 38 Nos. 1/2, and Part 4 in Volume 38 No. 3.