Engineering extracellular electron transfer pathways and electroactive biofilms: synthetic biology meets environments and energy

Song Hao

Abstract

Bioelectrochemial systems (BES), including microbial fuel cells, microbial electrolysis cells, microbial desalination cells and microbial electrosynthesis, are rapidly applied in many industrial sectors, e.g., environmental bioremediation, clean energy production, commodity and specialty chemicals synthesis. However, there is a significant bottleneck limiting the industrial applications of these BES systems, i.e., the efficiency of extracellular electron transfer (EET) is fairly low at the moment. To this end, I will present our recent research progresses in engineering microbial cells to promote the efficiency of EET via synthetic biology approaches. Combing bionanotechnology, we also engineered an electroactive biofilm which boost the EET's efficiency significantly. Thus, our research will push forward the further industrial adoption and applications of the BES systems.

Biography:

Dr. Song received his B.S. in Chemistry from Nankai University, and his Ph.D. in Chemical & Biomolecular Engineering from the University of Houston. Before joining in NTU on Nov. 2009, he worked as a postdoctoral fellow at the University of Texas, and a research associate at Duke University. His research interests are on the synthetic biology, systems & computational biology, and bioreactors and process engineering, focusing on microbial production of chemicals (including commodity chemicals & materials, functional foods and drugs) and environmental biotechnology.

Functional Nucleic Acid Probes for Bioanalysis and Biomedicine

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Over the last two decades, numerous functional nucleic acid probes including aptamers, riboswitches, ribozymes, and DNazymes have been discovered. The emergence of these functional nucleic acid probes has greatly changed our view on the role nucleic acids in life processes-they are not only the carriers of genetic information, they can also function as enzymes and receptors. More importantly, these functional nucleic acid probes have found their wide applications in bioanalysis and biomedicine including biomolecule sensing, biomarker discovery, drug screening, target delivery, gene regulation and disease diagnosis. In this talk, I will present some recent progress from our group on functional nucleic acid probe selection, optimization, structure modification and their applications in bioanalysis and biomedicine.

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Chaoyong James Yang received his B.S. (1998) and M. S. (2001) from Xiamen University, China. He studied for this Ph.D. in the Department of Chemistry at the University of Florida from 2001 to 2006. After completing his PhD dissertation, he conducted his postdoctoral research at the University of California, Berkeley. In 2008, he became a faculty member of Xiamen University and now is the Professor of Chemistry in the Department of Chemical Biology at Xiamen University. He won a Chinese Government Award for Outstanding Students Abroad (2005) and is the recipient of American Chemical Society DAC Graduate Fellowship in 2005 and CAPA Distinguished Faculty Award in 2012. His current research is particularly focused on molecular engineering, molecular recognition, high throughput evolution, and microfluidics.

Titanium Dioxide Nanostructures for Solar Energy Harvesting

Bin Liu

Abstract:

Titanium dioxide (TiO_2) is one of the most widely used semiconductors in photovoltaics and photocatalysis because it is nontoxic, abundant, stable and photoactive. However, the wide bandgap, low electron mobility and short minority carrier diffusion length of TiO_2 limit its quantum efficiency in these applications. In this talk, we present a solution chemical approach for making TiO_2 nanostructures (including rutile TiO_2 nanowires on fluorine-doped tin oxide substrate, anatase TiO_2 nanorods/nanoflakes on fluorine-doped tin oxide substrate, core-shell TiO_2 nanowires made of beta-phase core and anatase shell, and C-doped TiO_2 mesoporous microspheres) for improving the performance of TiO_2 in dye-sensitized solar cells (DSSCs), photoelectrochemical cells (PEC) and photocatalysis.

Biography:

Bin received his B.Eng. (2002) and M.Eng. (2004) in chemical engineering from the National University of Singapore with Professor Hua Chun Zeng and Ph.D. in chemical engineering from University of Minnesota (2011) with Professor Eray S. Aydil. He also worked as a postdoctoral researcher (2011-2012) in the Department of Chemistry at University of California, Berkeley with Professor Peidong Yang. He is currently an Assistant Professor in School of Chemical and Biomedical Engineering at Nanyang Technological University. Bin has extensive experience in synthesis of nanostructured materials and has been working on nanostructured materials for energy conversion and energy storage since 2002.

High-Nuclearity Metal Clusters as Molecular Magnets and Magnetic Coolers

Xiang-Jian Kong

Abstract

The exploratory synthesis and property investigation of molecule-based magnetic materials are of great current interest, largely stimulated by their envisioned technological applications. Most notable in this vein is the research on polynuclear metal complexes, many of which display fascinating molecular structures and interesting magnetic properties due to the unique exchange interactions between the metal ions. However, owing to the synthetic difficulty, high-nuclearity metal clusters are still very rare, which obstructs further studies of their physical and chemical properties. We have carried out the research on the synthesis, structures and magnetic properties of lanthanide (4f) or lanthanide-transition (3d-4f) metal clusters. Series of high-nuclearity 4f or 3d-4f clusters were obtained under metalloligand and mixed anion template strategy. The single molecular magnets (SMMs) and magnetocaloric effect (MCE) properties of high-nuclearity metal clusters were also investigated.

Biography:

Xiang-Jian Kong received his B.S. degree in chemistry from Liaocheng University in 2003 and his Ph.D. from Xiamen University in 2009 under the supervision of Professor La-Sheng Long. He is now an associate professor of Xiamen University. His research interests are in the fields of polynuclear lanthanide clusters and lanthanide-transition heterometallic clusters.