# UWMRF Bradley/Herzfeld Catalyst Grants
# Round IV Awards (Spring 2011, Announced in Summer 2011)

## *Bradley/Herzfeld Catalyst Phase 4 Awards ($435,000 awarded in summer 2011)*

The Research Foundation has selected eight new projects for funding in the fourth round of the Bradley Calalyst Grant Program. This is being funded by $360,000 from the Lynde and Harry Bradley Foundation and an additional $75,000 from the Richard and Ethel Herzfeld Foundation in their second round of support for the program. A total of $435,000 will be awarded to support these projects starting in the summer of 2011.

## *Catalyst Grant Award Winners:*

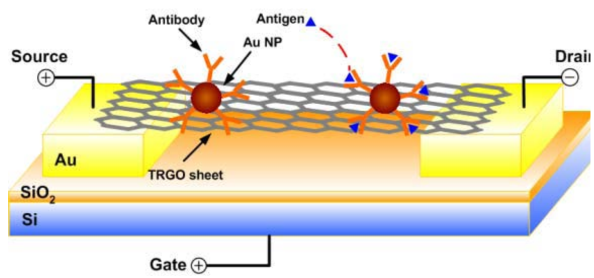
### Biosensor Based on Graphene Nanomaterials

**Junhong Chen**, Ph.D., Associate Professor, Department of Mechanical Engineering

**Project Overview:** Junhong Chen's innovations in the field of nanomaterials are the subject of multiple patent applications, and his startup company, NanoAffix Sciences has been awarded phase 1 small business innovative research (SBIR) grant to commercialize technologies for gas sensing applications.

Support for this project, "A Generic Biosensing Platform Based on Graphene," will allow Chen to explore a new application, sensing for biological applications. Most biological sensing systems employ a cumbersome process of mixing chemicals and measuring an optical signal. This novel system allows an electrical signal from a liquid sample such as blood to be read directly by an integrated circuit chip.

The nano-scale system employs graphene, a sheet made of a single layer of carbon molecules, and is small enough to allow many sensors to be integrated onto a single chip. In this project, Chen will explore sensing multiple proteins on a single chip, an important step toward proving the commercial viability of the technique that may allow the technology to be applied in the $12 billion market for biosensors.



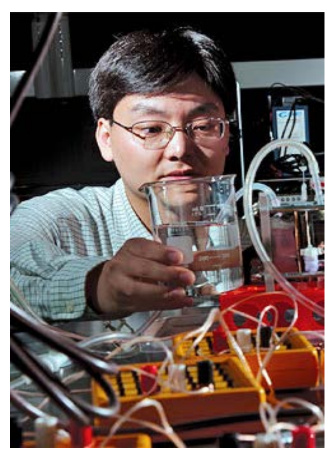

Junhong Chen's novel biosensor employs antibodies attached to a graphene sheet (made up of a single layer of carbon molecules) stretched between two electrodes; the presence of a target antigen can be detected electrically by the change in properties that occur when it binds to the antibody.

### Novel Enzymatic Water Softening Method

**Zhen He**, Ph.D., Assistant Professor, Department of Civil Engineering and Mechanics

**Project Overview:** Zhen (Jason) He is building a research program around innovative technologies of microbial fuel cells which use electrochemical reactions to remove contaminants from water while generating electricity. He is partnering with industry to scale up a method for desalination of water.

For this project, "A Novel Water Softener Based on Enzymatic Bio-electrochemical Reaction," Dr. He has partnered with a local entrepreneur to explore an innovative new method to soften water using enzymes rather than salt. Softening hard water often involves the use of salt which is cumbersome and creates further problems for water systems. Dr. He has proposed an innovative new method using enzymes which could offer a transformative technology in a market that exceeds $2 billion annually in the United States.



Zhen (Jason) He will apply his expertise in microbial fuel cells to a novel new method for water softening using enzymes.

UWMRF performed a technology/market assessment that set performance benchmarks, and this funding will help determine whether or not this technology can compete and form the basis for a new startup company. Funding will also provide important "reduction to practice" of the concept that may be needed to convert the existing provisional patent application to a formal utility patent application.

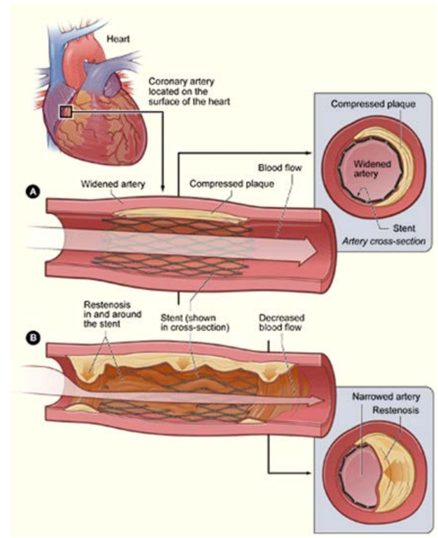
## Design of New Medical Device Coatings

**Changsoo Kim**, Ph.D., Assistant Professor, Materials Department

**Project Overview:** Changsoo Kim joined UWM in 2009 after conducting materials research at the Food and Drug Administration (FDA).

In this project, "Multi-layer Drug-Polymer Coating Development for Drug-Eluting Stent (DES) Medical Device," Kim will apply his expertise in computational modeling and materials science to the challenge of designing better coatings for medical devices such as cardiac stents.

Support for this project allow Kim to develop an analytical model for the fracture mechanics of polymer drug coatings used in drug-eluting stents. This model will be validated with analytical testing and may eventually lead to new and better device coatings.




Changsoo Kim will seek to develop better devices coatings or use in devices such as cardiac stents (A) to prevent re-narrowing (B) that can occur after implantation.

Dr. Kim has recently established connections with scientists a major manufacturer of these devices. Preliminary data from this project will help Kim to pursue major grants from the National Science Foundation (NSF) and National Institutes of Health (NIH).

## Power Electronics for Integrating Wind Turbines with Power Grid

**Adel Nasiri**, Ph.D., Associate Professor, Department of Electrical Engineering and Computer Science

**Project Overview:** Adel Nasiri's research efforts are closely aligned with research partnerships between UWM and regional companies in the energy sector. He has a track record of working with industry and was recently recognized by Engineers and Scientists of Milwaukee as 2010 Milwaukee Young Engineer of the Year.

This project, "Grid Frequency Support and Inertia Emulation Using Distributed Energy Storage Systems for Wind Turbines," addresses a key challenge in integrating wind turbines with the electrical grid. Wind turbine energy, by its nature, varies as winds increase and decrease; this creates challenges in integrating these turbines with the shared power grid where power companies are required to maintain tight controls on voltage levels. Nasiri is developing innovative control topologies that use new energy storage devices including ultra capacitors (a new generation of capacitors for short term energy storage).

Adel Nasiri was recently named 2010 Milwaukee Young Engineer of the Year by Engineers and Scientists of Milwaukee.

The UWM Research Foundation has filed a utility patent application on Nasiri's innovative design. Support from this grant will help validate the concept, further technology licensing efforts and will hopefully lead to follow up studies with wind turbine manufacturers or makers of power electronics devices.

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## Water Purification System Using Modified Zeolite

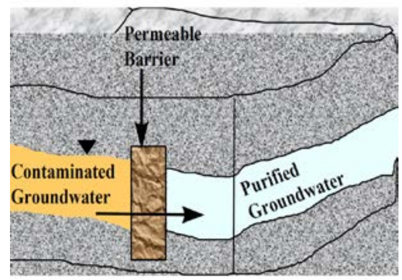
**Shangping Xu**, Ph.D., Assistant Professor, Department of Geosciences

**Project Overview:** Shangping Xu's primary research interest lies in the protection of water resources and the supply of safe drinking water. As a faculty member in UWM's Department of Geosciences, Xu brings another important perspective to water technologies and efforts by UWM and the Milwaukee region to develop a water industry cluster.

Xu is proposing a new method to remove chromate, arsenate and *E. coli.* from groundwater. Zeolite is an inexpensive, naturally-occurring mineral with a large capacity for cation exchange. This makes it effective in removing positively charged heavy metals from groundwater, but it generally isn't effective against anionic contaminants such as chromate and arsenate as well as many pathogens.

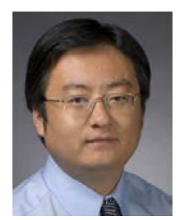
Support for this project, "Development of Green Solvent Modified Zeolite (GSMZ) for the Removal of Chemical Contaminants and Pathogens from Water," will allow Xu to test a new concept in modified Zeolite which uses imidazolium group of compounds, which are considered to be "green solvents," as a surfactant to modify Zeolite.

If successful, this work may be employed by environmental consulting firms and municipalities around the country to implement ground water remediation strategies, including over 100 sites in the United States that have been identified as contaminated by chromate. It may also provide a means to address contamination by hexavalent chromium, a known carcinogen that has been found in as many as 89% of samples collected from municipal water systems in the United States.




Shangping Xu is developing a modified form of an inexpensive mineral, Zeolite, to be used in remediating chromate and other contaminates from groundwater.

## New Low-Cost Solar Cell Technology

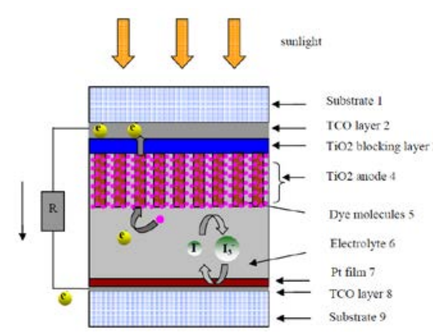


**Chris Yuan**, Ph.D., Assistant Professor, Department of Mechanical Engineering

**Project Overview:** Chris Yuan's research interests include sustainable (green) manufacturing and the study of nano-materials/structure for sustainable energy development. These interests converge in this project which seeks to improve upon a low-cost solar cell technology known as dye sensitized solar cells (DSSC).

Dye sensitized solar cells are an attractive alternative in the pursuit of clean energy sources because they use low-cost materials and don't require the expensive manufacturing techniques associated with other solar cell technologies; however, the conversion efficiency (amount of energy produced for a given solar illumination) is too low to make these devices a practical alternative to existing technologies.

Support for this project, "A Hybrid Nano-structure for High-efficiency Dye-sensitized Solar Cell," will allow Yuan to test his concept which employs a novel configuration of nanostructures to improve efficiency of these solar cells. The concept includes Titanium Dioxide nanotubes to improve the collection efficiency and nano-scale pinholes to prevent electrons from recombining. If successful, this project may lead to a development partnership with a major producer of solar cells such as SunTech.




Chris Yuan proposes novel nano-structures to improve solar cells including TiO2 nanotubes to improve collection efficiency and nano-scale pinholes to prevent electron recombination.

### *Gap Fund Award Winners:*

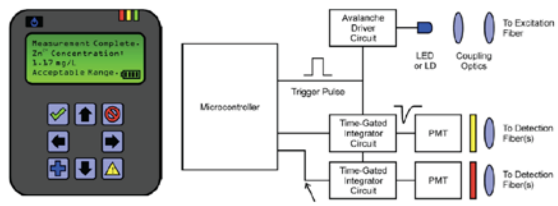
## Prototype Optical Sensors for Water Quality

**Peter Geissinger**, Ph.D., Associate Professor, Department of Chemistry and Biological Science

**Project Overview:** Peter Geissinger first established his collaboration with Advanced Chemical Systems (ACS) in 2009 on the strength of a Bradley Catalyst Grant. Geissinger developed a method for measuring impurities in water using fiber optics, and ACS, a Milwaukee-based company that sells water purification systems and chemicals to industrial users, saw a new application for Geissinger's work in measuring metals in industrial waste streams.

The initial catalyst grant helped Geissinger, and his post-doctoral researcher, Dr. Paul Henning, make key improvements to the laboratory instrument. The instrument was redesigned to use an inexpensive laser-diode instead of the expensive and cumbersome laser system that was used in the initial testing.

ACS has brought an essential "market-pull" to the technology development of Geissinger and his team. Working with Geissinger and Henning, ACS has filed three small business innovative research (SBIR) grant applications to help advance the development of the instrument. This gap fund award will help further refine the device into a portable unit that ACS can ultimately take to market for their industrial customers.




Peter Geissinger's research team will continue its collaboration with Milwaukee-based water company Advanced Chemical Systems to develop a portable unit for measuring water quality in industrial settings.

## Compounds to Combat Pathogens in Humans and Plants

**Ching-Hong Yang**, Ph.D., Associate Professor, Department of Biological Sciences

**Project Overview:** Ching-Hong Yang's work in functional genetics lead him to identify a key signaling pathway that is responsible for the survival of human and plant pathogens. Yang and his collaborators used this insight to design new antibiotics that can address a growing problem of antibiotic resistance. Yang's compounds essentially render pathogens harmless without killing them, thereby eliminating the natural selection pressure that leads to antibiotic resistance.

This work was supported by a Bradley Catalyst Grant in 2010, and results from this phase of research helped to attract the interest of an agricultural company, Wilbur-Ellis, and a company interested in the compounds for human uses, Creative Antibiotics. UWMRF has entered into a partnership with Duke University, where the compounds were first synthesized, to pursue patent protection and market the technology.

A key challenge in commercializing the technology is to synthesize the compounds in sufficient quantities for testing. This gap fund award will support Yang's project, "Small Molecule Inhibitors of Type III Secretion in Human and Plant Pathogens," and allow Yang and his collaborators to synthesize more compounds among a large library of compounds protected by a multiple patent applications and continue testing of these compounds.