ERIF 2009 Mid-term Report: Bishnoi Lab

Project title: Using *Daphnia Magna* and Surface Enhanced Raman Scattering Imaging (SERSI) to Explore the Ecotoxicity of Metal Nanoparticles

Progress to date: We tested three particle compositions between January and June 2009, citrate reduced gold colloid, THPC Au colloid and citrate reduced silver colloid. We found that both of the gold nanoparticle solutions showed a low dose toxicity of 50% of the Daphnia magna population (LD50) between 50 - 70 mg/L (ppm) after a 48 hour exposure to the nanoparticle solutions. This was significantly higher than previously reported in literature (500ppb). We suspect that the major difference is that previous studies with gold nanoparticles used a commercially available particle solution that contained a preservative (sodium azide) that is known to be toxic. Since our particle solutions contained no such preservative, it required significantly higher concentrations to see the same level of toxicity within the Daphnia population.

Tests with silver colloid solutions showed significantly higher levels of toxicity within the Daphnia magna species. Solutions as low as 1µg/L (ppb) were shown to have some level of toxicity to the species and an LD 50 of 2ppb. We have shown that this toxicity level can be decreased by ~3X through the chemical modification of the silver surface with a thiolated poly(ethylene) glycol layer prior to exposure to Daphnia.

We have presented our work on nanotoxicity at the following conferences to date:

Nanotech 2009 (2 posters)
Chicago Area Undergraduate Research Symposium (1 poster)
Nanomaterials Application Center Symposium (1 talk)
American Chemical Society Great Lakes Regional Meeting (1 poster, 1 talk)

This summer we are continuing these studies with the following participants:

- Angela Isom (Chicago City College student - REU student supported by NSF Illinois LSAMP Program)
- Maritza Rodriquez (High School student - Project SEED student supported by American Chemical Society)
- Shawn Kamal (High School student - Project SEED student supported by American Chemical Society)
- Leigha Ingham (High School teacher - ACS Scholar supported by American Chemical Society)
- Ting Li (IIT M.S. student – will be supported by ERIF in Fall 2009)
- Yiming Huang (IIT Ph.D student – will be supported by ERIF in Fall 2009)

Proposals submitted to date related to ERIF grant:

NSF CBET: Investigation of the Environmental Toxicity of Metal Nanoparticles (PI. Co-PI's: V. Perez-Luna, C. Zhang)	2 YR	$241,734
NIH: Nanoparticle Sensing of Highly Reactive Oxygen and Nitrogen Species	2 YR	$284,799
NIH: Evaluating the Impact of Nanoparticles on Health (ARRA) (Subcontract from UW-Milwaukee)	2 YR	$282,326

Future directions:

-Support for this project has resulted in an invitation to submit a paper on the analytical aspects related to nanotoxicology for publication in the September 2010 issue of the journal *Analytical and Bioanalytical Chemistry*.

-We will continue investigating the role of particle composition, surface chemistry, and size in the toxicity of metal nanoparticles to Daphnia magna.

-The remaining ERIF funds will be used to support two graduate students in the Fall 2009 semester (Yiming Huang and Ting Li)