Nanotechnology at EPA: Focus on Remediation

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Federal Remediation Roundtable

EPA Nanotechnology Research

applications

- Green manufacturing
- Green energy
- Sensors
- Treatment
- Remediation

implications

- Toxicology
- Fate, transport, and transformation
- Exposure, bioavailability, and bioaccumulation

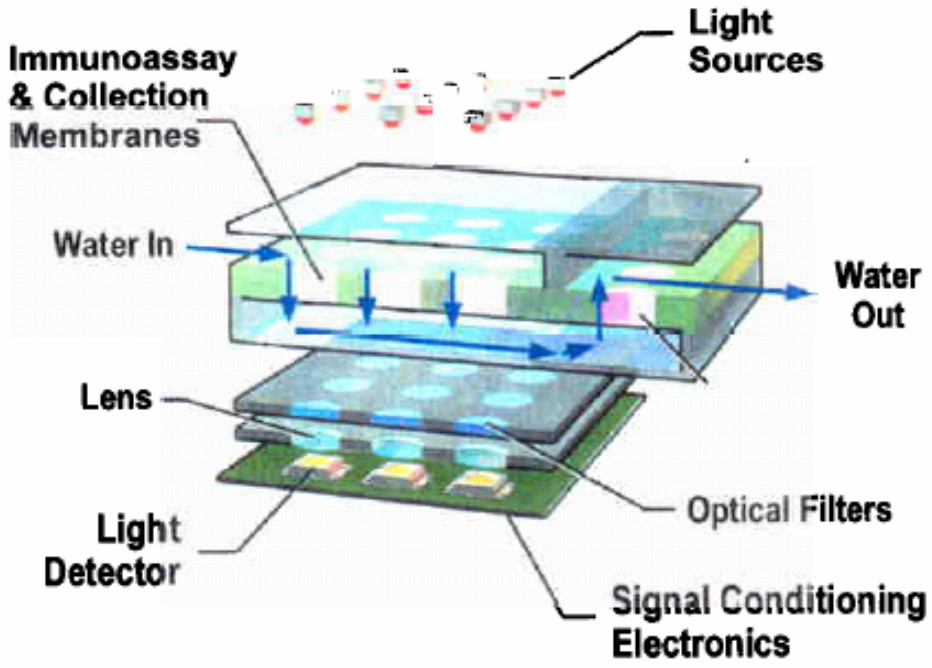
EPA Research Programs for Nanotechnology

- STAR competitive research grants to academia ~ $ 5 M /yr
- SBIR competitive research contracts to small companies ~ $ .5 – 1 M/yr

Nanotechnology & SBIR

- Phase I, $70K
  - "Nanocomposite-Based Filter for Arsenic Removal in Drinking Water" – Materials Modification, Inc.
  - "Nano Alumina Arsenic Filter", Argonide Corp,, 2003
  - "Development of High Surface Area Material and Filter Media" – eSpin Technologies, Inc., 2003
  - "Multi-Analyte Nanoelectronic Air Pollutant Sensor" – Nanomix, Inc, 2004
- Phase II, $300K
  - "Nanoparticle Enhanced Immunoassay for Monitoring Organic Pollutants" – Intelligent Optical Systems, 2004

Nanoparticle Enhanced Immunoassay for Monitoring Organic Pollutants, Intelligent Optical Systems, Phase II - $300K



Flow cell and membranes for multiple assay target detection. Depiction of a "microtiterplate like" arrangement with multiple light sources and detectors for the assay of multiple contaminants.

STAR Research on Nanotechnology Applications

- **Solicitations in 2001 and 2002: 32 Projects, $11M**

  - Green Manufacturing – 7
  - Remediation – 6
  - Sensors – 11
  - Treatment – 4
  - Aerosols –2
  - Environmental Implications – 2

Nanotechnology & STAR - Remediation

- "Dendritic Nanoscale Chelating Agents: Synthesis, Characterization, Molecular Modeling and Environmental Applications" - *Mamadou Diallo Howard University, 2002*
- "Membrane-Based Nanostructured Metals for Reductive Degradation of Hazardous Organic at Room Temperature" - *Dibakar Bhattacharyya University of Kentucky, 2002*
- "Nanoscale Bimetallic Particles for In Situ Remediation" - *Wei-xian Zhang, Lehigh University, 2002*
- "A Bioengineering Approach to Nanoparticle Based Environmental Remediation" - *Daniel Strongin, Temple University, 2002*
- "Functional Fe(0)-Based Nanoparticles for *In Situ* Degradation of DNAPL Chlorinated Organic Solvents" - *Gregory Lowry, Carnegie Mellon University, 2003*
- "Nanostructured Catalytic Materials for NOx Reduction Using Combinatorial Methodologies" - *Selim Senkan, University of California, Los Angeles, 2003*

Nanotechnology & STAR - Treatment

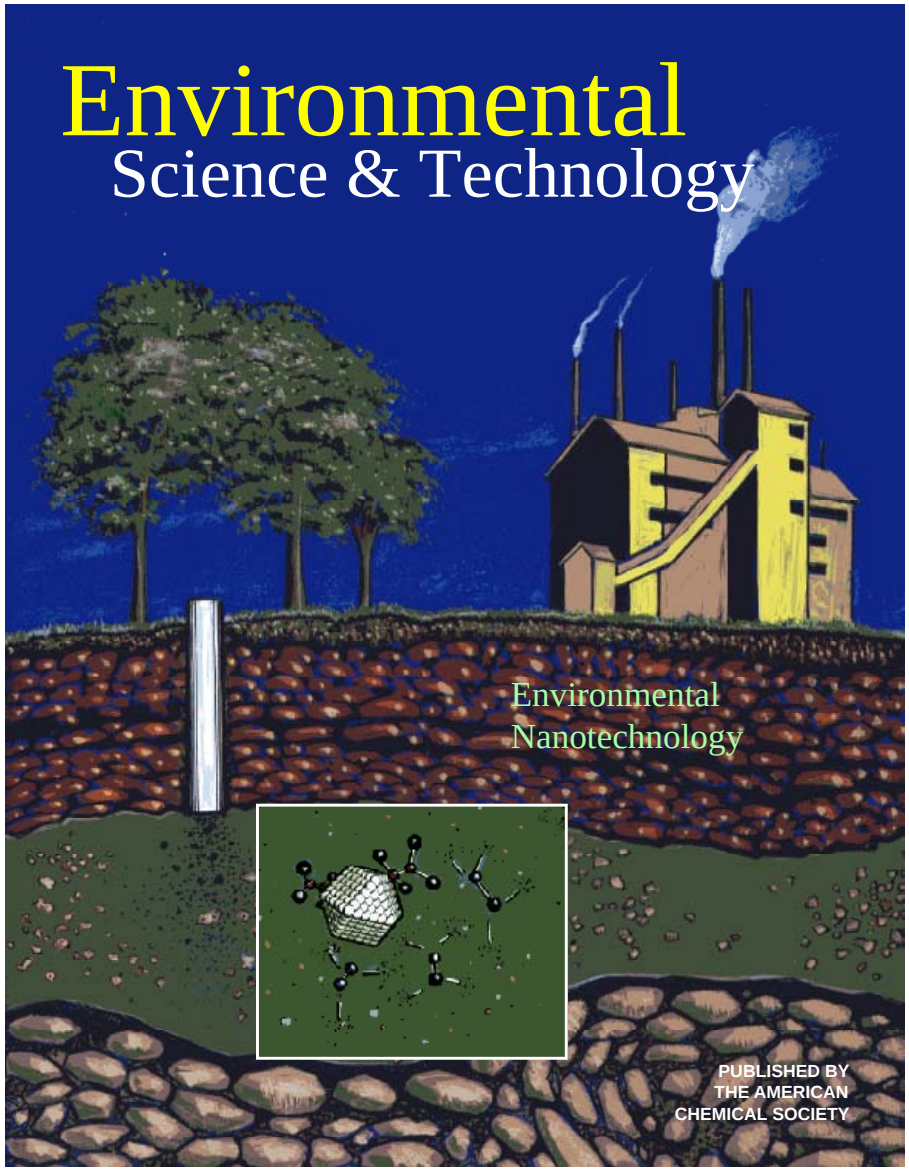
- "Synthesis, Characterization and Catalytic Studies of Transition Metal Carbide Nanoparticles as Environmental Nanocatalysts" - *Ismat S. Shah, University of Delaware, 2002*

- "Simultaneous Environmental Monitoring and Purification through Smart Particles" - *Wolfgang Sigmund, University of Florida, 2002*

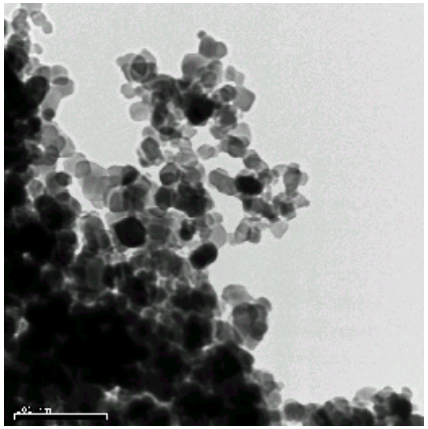
- "Nanoscale Biopolymers with Tunable Properties for Improved Decontamination and Recycling of Heavy Metals" - *Wilfred Chen, University of California, Riverside, 2002*

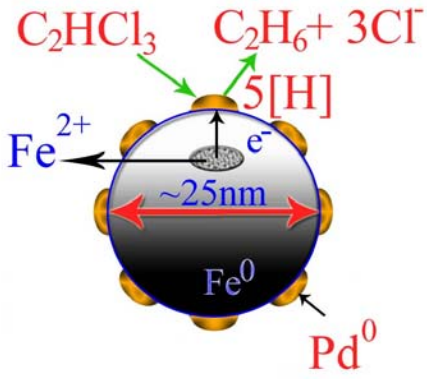
- "Use of Ozonation in Combination with Nanocomposite Ceramic Membranes for Controlling Disinfection By-Products" - *Susan Masten, Michigan State University, 2003*

Wei-xian Zhang, Lehigh



Remediation of Groundwater

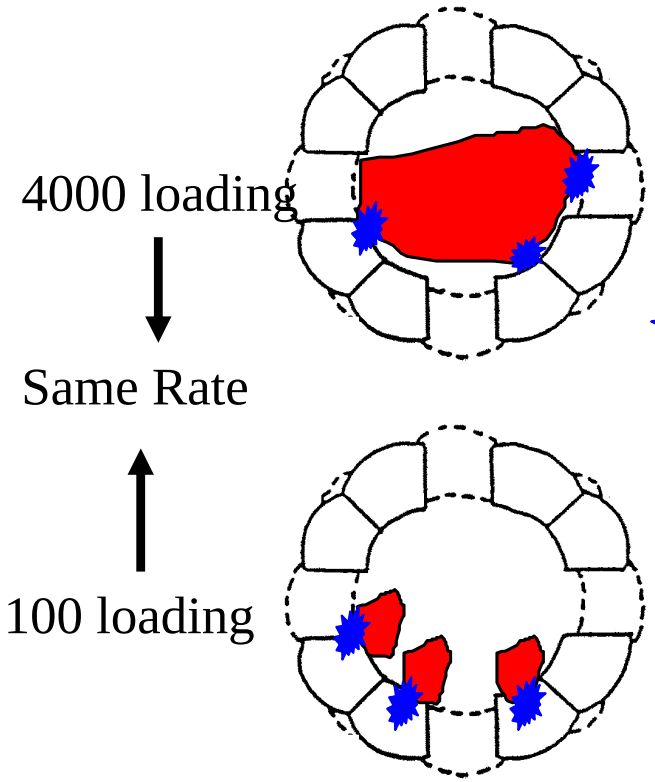




TCE reduction with nano Iron

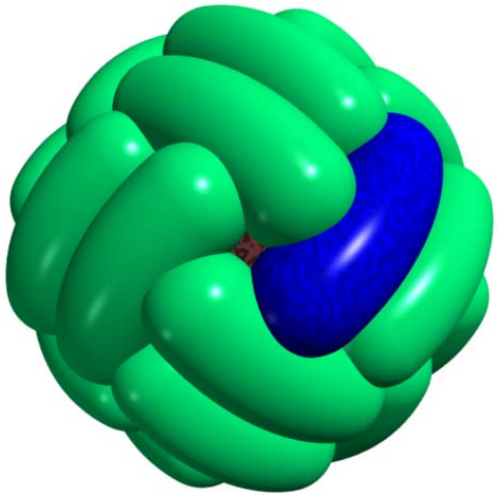
- Oxidation of pollutant enhanced by coupling with other metals (Fe/Pd)* on the nanoscale.
- Smaller size penetrates difficult to access areas; large reactive surface area.

Protein-encapsulated iron oxide particles for cleanup of organics



Only inorganic oxide in contact with shell appears to take part in e- transfer

e⁻ transfer points



Ferritin spherical protein cage (120 μ) with Fe_2O_3)

This research involves the development of catalysts for the reduction of chlorinated compounds using a variety of homogeneous nano-sized metal and metal oxide particles. Zero-valence Fe particles within a protein cage were tested. **Daniel Strongin, Temple University**

More Information

- NCER web site contains abstracts and progress/final summaries for all funded projects.
- www.epa.gov/ncer
- “Search” -- nanotechnology

Future Research

- Currently focusing on risk assessment
  - Exposure; health and environmental effects
- Possibility for collaboration with other agencies on remediation