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*Elton Z. and Lois G. Huff Associate Professor of Civil/Environmental Engineering*

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### **EDUCATION**

- Ph.D. Lehigh University, Bethlehem, PA, 1998, Civil and Environmental Engineering.  
(Advisor: Arup K. SenGupta; GPA: 3.9/4.0)
- M.S. Taiyuan University of Technology, China, 1987, Environmental Engineering.
- B.S. Taiyuan University of Technology, China, 1984, Civil & Environmental Engineering  
(Rank: No. 1 of 150 students)

### **PRIMARY RESEARCH INTERESTS**

- Physical and chemical processes (sorption, ion exchange, membrane, and environmental catalysis) for treatment of water/wastewater and for remediation of soil/sediment
- Nanoscale materials and nanotechnologies for environmental remediation uses; Environmental fate and impacts of man-made nanoparticles
- Physical and biological availabilities of contaminants in soils and sediments
- Treatment of water treatment process waste residuals
- Multi-phase mass transfer and transport modeling of contaminants
- Indoor air quality
- Transportation and the environment

### **MAJOR EXPERIENCE**

- 8/2007-present **Huff Associate Professor**, Dept. of Civil Engineering, Auburn University, AL.
- 8/2006- present **Associate Professor with Tenure**, Dept. of Civil Engineering, Auburn University, AL.
- 7/2001 – 7/2006 **Assistant Professor**, Department of Civil Engineering, Auburn University, Auburn, AL.
- 3/1999 – 6/2001 **Postdoctoral Scientist**, Department of Soil & Water, The Connecticut Agricultural Experiment Station, New Haven, CT. (Supervisor: Joe Pignatello)
- 8/2000 – 5/2001 **Adjunct Faculty**, Environmental Science and Studies Program, Teikyo Post University, Waterbury, CT 06723, USA.
- 9/1997 - 2/1999 **Research Associate**, Dept. of Civil and Environ. Eng., Virginia Tech, Blacksburg, VA. (Supervisor: John C. Little)
- 10/1993 - 8/1997 **Doctoral Fellow**, Dept. of Civil & Environ. Eng., Lehigh University, PA.
- 6/1992 - 7/1993 **Visiting Scholar**, Technical University of Munich, Germany.
- 2/1991 - 2/1992 **Visiting Research Scholar**, University of Kassel, Germany.
- 7/1988 - 9/1990 **Instructor**, Dept. of Environmental Eng., Taiyuan Univ. of Tech., China.
- 8/1987 – 6/1988 **Volunteer** for training middle school teachers in remote regions, Liulin, Shanxi, China.

### **SELECTED PUBLICATIONS**

#### Journal Papers

- [1] Z. Xiong and **D. Zhao** (2008) "Rapid and controlled transformation of nitrate in water and brine using stabilized iron nanoparticles" *J. Nanoparticle Res.* (in review)
- [2] Z. Xiong, F. He, **D. Zhao**, M. Barnett (2008) "In-situ Immobilization of Mercury in Sediment by Stabilized Iron Sulfide (FeS) Nanoparticles" *Environ. Sci & Technol.* (in review)
- [3] F. He, M. Zhang, **D. Zhao** (2008) "Transport of Carboxymethyl Cellulose Stabilized Iron Nanoparticles in Porous Media and Application to in situ Degradation of Trichloroethylene" *Environ. Sci & Technol.* (in review)
- [4] G. Pan, C. Jia, **D. Zhao**, C. You, H. Chen, B. Tian, G. Jiang (2007) "Effect of cationic and anionic surfactants on the sorption and desorption of perfluorooctane sulfonate (PFOS) on natural sediments" *Environ. Pollution* (in review)
- [5] R. Liu, **D. Zhao**, M. O. Barnett, and G. Pan (2008) "Influences of soil compositions on leachability and bioaccessibility of Cu(II) in soils" *J. Environmental Management* (in review)
- [6] F. He and **D. Zhao** (2008) "Hydrodechlorination of trichloroethene using stabilized Fe-Pd nanoparticles: reaction mechanism and effects of stabilizers, catalysts and reaction conditions" *Applied Catalysis B* (in press)
- [7] K. Xu, W.F. Harper, **D. Zhao** (2008) "Ethinylestradiol sorption to activated sludge biomass: Thermodynamic properties and reaction mechanisms" *Water Research* (In press)
- [8] P.S. Dimick, A. Kney, J. Tavakoli, S.E. Mylon, **D. Zhao** (2008) "A Comparison of Metal-Loaded DOW3N Ion Exchangers for Removal of Perchlorate from Water" *Separation Sci. & Technol.* (in press)
- [9] F. He and **D. Zhao** (2008) "Response to comments on 'Manipulating the size and dispersibility of zerovalent iron nanoparticles by use of carboxymethyl cellulose stabilizers'" *Environ. Sci & Technol.* 42(9) 3480–3480.
- [10] SR Kanel, RR Goswami, TP Clement, MO Barnett, and **D. Zhao** (2008) "Transport of surface modified zerovalent iron nanoparticles in porous media: Experimental studies and numerical modeling" *Environ. Sci & Technol.* 42(3), 896-900.
- [11] Y. Xu, **D. Zhao**, and P. Clement (2008) "Modeling the elution histories of copper and lead from a contaminated soil with Polyamidoamine (PAMAM) dendrimers" *J Environ. Eng. (ASCE)*, 134(4), 238-246.
- [12] J. Liu, F. He, **D. Zhao** and C. Roberts (2008) "Polysugar-stabilized Pd nanoparticles exhibiting high catalytic activities for hydrodechlorination of environmentally deleterious trichloroethylene" *Langmuir*, 24(1), 328-336.
- [13] W. Li, G. Pan, M. Zhang, **D. Zhao**, Y. Yang, H. Chen, G. He. (2008) "EXAFS studies on adsorption irreversibility of Zn(II) on TiO<sub>2</sub>: Temperature dependence" *J. Colloid and Interface Sci.* 319(2), 385-391.
- [14] S.H. Joo and **D. Zhao** (2008) "Destruction of lindane and atrazine using stabilized iron nanoparticles under aerobic and anaerobic conditions: Effects of catalysts and stabilizer" *Chemosphere.* 70(3), 418-425.
- [15] Z. Xiong, **D. Zhao** and W. Harper (2007) "Sorption and desorption of perchlorate with various ion exchangers: a comparative study" *Ind. Eng. Chem. Res.* 46, 9213-9222.
- [16] R. Liu and **D. Zhao** (2007) "In situ immobilization of Cu(II) in soils using a new class of iron phosphate nanoparticles" *Chemosphere*, 68, 1867-1876.
- [17] R. Liu and **D. Zhao** (2007) "The leachability, bioaccessibility, and speciation of Cu in the sediment of channel catfish ponds" *Environmental Pollution* 147(3), 593-603.
- [18] F. He and **D. Zhao** (2007) "Manipulating the Size and Dispersibility of Zero-Valent Iron Nanoparticles by Use of Carboxymethyl Cellulose Stabilizers" *Environ. Sci & Technol.* 41(17), 6216-6221.
- [19] R. Liu and **D. Zhao** (2007) "Reducing leachability and bioaccessibility of lead from soils using a new class of stabilized iron phosphate nanoparticles" *Water Research*, (41), 2491-2502.
- [20] Z. Xiong and **D. Zhao** (2007) "Complete destruction of perchlorate in water and ion exchange brine using stabilized iron nanoparticles" *Water Research*, (41), 3497-3505.
- [21] F. He, **D. Zhao**, J. Liu and C. Roberts (2007) "Stabilization of Fe-Pd bimetallic nanoparticles with sodium carboxymethyl cellulose for enhanced degradation of TCE in water" *Ind. Eng. Chem. Res.* 46, 29-34.
- [22] Y. Xu and **D. Zhao** (2007) "Reductive immobilization of chromate in soils and groundwater by stabilized zero-valent iron nanoparticles" *Water Research*, (41), 2101-2108.
- [23] J. Snelling, M. O. Barnett, **D. Zhao**, and J. S. Arey (2007) "Methyl tertiary hexyl ether and methyl

- tertiary octyl ether as gasoline oxygenates: Anticipating widespread risks to community water supply wells” *Environmental Toxicology and Chemistry* 26(11), 2253-2259.
- [24] Y. Xu and **D. Zhao** (2006) “A revised method for determination of apparent stability constant of metal-dendrimer complexes” *Ind. Eng. Chem. Res.* 45: 7380-7387.
- [25] J. Snelling, M.O. Barnett, D. Zhao, and J.S. Arey (2006) “Methyl Tertiary Hexyl Ether and Methyl Tertiary Octyl Ether as gasoline oxygenates: Assessing risks from atmospheric dispersion and deposition” *J. Air & Waste Manage. Assoc.* 56: 1484-1492.
- [26] R. Liu, **D. Zhao**, and M. O. Barnett (2006) “Fate and Transport of Copper Applied in Channel Catfish Ponds: A Pilot Study” *Water, Air & Soil Pollution*, 176 (1-4): 139-162.
- [27] Z. Xiong, P. Dimick, **D. Zhao**, A. Kney, and J. Tavakoli (2006) “Removal of Perchlorate from Contaminated Water Using a Regenerable Polymeric Ligand Exchanger” *Separation Sci. & Technol.* 41 (11): 2555-2574.
- [28] Y. Xu and **D. Zhao** (2006) “Removal of lead from contaminated soils using poly(amidoamine) dendrimers” *Ind. Eng. Chem. Res.* 45, 1758-1765.
- [29] Y. Xu and **D. Zhao** (2005) “Removal of copper from contaminated soil by use of poly(amidoamine) dendrimers” *Environ. Sci & Technol.* 39, 2369-2375.
- [30] F. He and **D. Zhao** (2005) “Preparation and characterization of a new class of starch-stabilized bimetallic nanoparticles for degradation of chlorinated hydrocarbons in water” *Environ. Sci & Technol.* 39, 3314-3320.
- [31] B. An, T. Steinwinder, and **D. Zhao** (2005) “Selective removal of arsenate from drinking water using a polymeric ligand exchanger” *Water Research* 39, 4993-5004.
- [32] A. D. Kney and **D. Zhao** (2004) “A Pilot Study on Phosphate and Nitrate Removal from Secondary Wastewater using a Selective Ion Exchange Process” *Environ. Technol.*, 25(5), 533-542.
- [33] W. D. Henry, **D. Zhao**, C. Lange, and A. K. SenGupta (2004) “Preparation and Characterization of a New Class of Polymeric Ligand Exchangers for Selective Removal of Trace Contaminants from Water” *Reactive and Functional Polymer*, 60:109-120.
- [34] **D. Zhao** and J. Pignatello (2004) “Model-Aided Characterization of Tenax Resins for Sorption of Aromatic Compounds from Water” *Environ. Toxic. Chem.* 23(7), 1592-1599.
- [35] **D. Zhao**, J. Little and S. Cox (2004) “Characterization Polyurethane Foam as a Source for or Sink of VOCs in Indoor Air” *J. Environ. Eng.*, ASCE 130(9), 983-989.
- [36] R. Liu, **D. Zhao**, M. O. Barnett, and C. Boyd (2003) “Fate and transport of copper in copper-sulfate treated fish ponds” *J. Environ. Monitoring and Restoration*, Special Issue based on the 2003 International Conference on Safe Water, Ibeanusi V.M., Editor, 1-8.
- [37] W. Braida, J. White, **D. Zhao** and J. Pignatello (2002) “Concentration-Dependent Kinetics of Pollutant Desorption from Soils” *Environ. Toxic. Chem.*, 21(12), 2573-2580.
- [38] **D. Zhao**, J. Pignatello, M. Hunter, and J. White (2002) “Application of the Dual-Mode Model for Predicting Competitive Sorption Equilibria and Rates of Polycyclic Aromatic Hydrocarbons in Estuarine Sediment Suspensions” *Environ. Toxic. Chem.*, 21(11), 2276-2282.
- [39] **D. Zhao**, J. C. Little, and A. Hodgson (2002) “Modeling Sink Effects of Building Materials in Response to Transient Contaminant Sources” *Indoor Air*, 12, 184-190.
- [40] **D. Zhao**, J. Pignatello, J. White, and M. Hunter (2001) “Dual-Mode Modeling of Competitive and Concentration-Dependent Sorption and Desorption Kinetics of Hydrophobic Contaminants in Soils” *Water Resources Res.*, 37, 2205-2212.
- [41] S. Cox, **D. Zhao**, and J. C. Little (2001) “Measuring Partition and Diffusion Coefficients for Volatile Organic Compounds in Vinyl Flooring” *Atmospheric Environ.* 35, 3823-3830.
- [42] **D. Zhao** and A. K. SenGupta (2000) “Ligand Separation with a Cu(II)-Loaded Polymeric Ligand Exchanger” *Ind. & Eng. Chem. Res.* No. 2, Vol. 39, 455-462.
- [43] **D. Zhao**, A. K. SenGupta, and L. Stewart (1998) “Selective Removal of Cr(VI) Oxyanions with a New Anion Exchanger” *Ind. & Eng. Chem. Res.*, Vol. 37, No. 11, 4383-4387.
- [44] **D. Zhao** and A. K. SenGupta (1998) "Ultimate Removal and Recovery of Phosphate from Wastewater Using A New Class of Polymeric Exchangers" *Water Res.*, No. 5, Vol. 32, 1613-1625.
- [45] **D. Zhao** and A. K. SenGupta (1996) "Selective Removal and Recovery of Phosphate in a Novel Fixed-

Bed Process" *Wat. Sci. & Tech.*, Vol. 33, No. 10-11, 139-147.

- [46] A. K. SenGupta and **D. Zhao** (1996) "Book Review: Ion Exchanger and Solvent Extraction, Vol. 12, by Marinsky and Marcus" *J. Environ. Progress.*, Vol. 15, No. 4, w9-w10.
- [47] **D. Zhao**, A. K. SenGupta, and Y. Zhu (1995) "Trace Contaminants Sorption through Polymeric Ligand Exchange" *Ind. & Eng. Chem. Res.*, Vol. 34, No. 8, 2676-2684.

#### Book Chapters

- [1]. F. He, **D. Zhao** and C. Roberts (2008) "Stabilization of Zero-Valent Iron Nanoparticles for Enhanced in situ Destruction of Chlorinated Solvents in Soils and Groundwater" in *Nanotechnology for Water Quality* Eds. Diallo M; Savage N; Street A; Sustich R. William Andrew Publishing, (in press)
- [2]. Y. Xu, R. Liu, and **D. Zhao** (2008) "Reducing Leachability and Bioaccessibility of Toxic Metals in Soils, Sediments and Solid/Hazardous Wastes Using Stabilized Nanoparticles" in *Nanotechnology for Water Quality* Eds. Diallo M; Savage N; Street A; Sustich R. William Andrew Publishing, (in press)

#### U.S. Patents

- [1]. A. K. SenGupta and **D. Zhao** (2000) "Selective Removal of Phosphate and Chromate by Ion Exchangers" U.S. Patent No. 6,136,199.
- [2]. **D. Zhao** and F. He (2004) "Preparation and application of a new class of starched bimetallic nanoparticles for dechlorination of chlorinated hydrocarbons in soils and water" U.S. Patent Application #60/584,063.
- [3]. **D. Zhao** and B. An (2005) "Selective removal of arsenate using polymeric ligand exchangers" U.S. Patent Application #60/687,611.
- [4]. **D. Zhao**, Z. Xiong, M.O. Barnett, and W. Harper (2006) "In situ immobilization/containment of mercury in soils and sediments using a new class of metal sulfide nanoparticles" U.S. Provisional Patent #60/777,309.
- [5]. **D. Zhao** and Z. Xiong (2006) "Complete destruction of perchlorate and nitrate in water and brine using stabilized iron-based nanoparticles" U.S. Provisional Patent # 60/787,626.
- [6]. **D. Zhao** and R. Liu (2006) "In situ immobilization of heavy metals using a new class of stabilized nanoparticles" U.S. Provisional Patent #60/860,305.
- [7]. **D. Zhao** and Y. Xu (2006) "Reductive immobilization of chromate in soils/solid wastes using a new class of stabilized iron nanoparticles" U.S. Provisional Patent #US60/872,616.

#### Full Papers in Proceedings

- [1] T. R. Steinwinder, **D. Zhao**, J. Mullen (2007) "Minimizing arsenic leaching from water treatment process residuals" in Proceedings of 2007 WEFTEC (Water Environment Federation Technical Exhibition and Conference), Chicago, IL, October 19-22.
- [2] **D. Zhao**, J.C. Little, and S. Cox (2003) "Sorption/Desorption Behavior of Polyurethane Foam" *The 4th International Symp. on HVAC*, Beijing, China, Oct. 9-11 (Paper accepted).
- [3] **D. Zhao** and J. C. Little: "Modeling and experimental investigation of source/sink effects of polyurethane foam on indoor VOC concentrations", Healthy Buildings, 7th International Conference *Energy-Efficient Healthy Buildings* Singapore, December 7-11, 2003, Singapore (Paper accepted)
- [4] Kney, A. D., B. Dreibelbis, **D. Zhao**, and A. K. SenGupta (2002) "A Pilot Study-Phosphate and Nitrate Removal from Treated Domestic Wastewater using a Unique Enhanced Ion Exchange Process" CSCE/EWRI of ASCE Environmental Engineering Conference Proceeding, Niagara Fall, NY, July 2002.
- [5] **D. Zhao**, S. S. Cox, and J. C. Little (1999) "Source/Sink Characterization of Diffusion-Controlled Building Materials" *Proc. of 8th International Conf. on IAQ&C*, Vol 1, 408-413. International Academy of Indoor Air Sciences, Edinburgh, Scotland, 8-13 August, 1999.
- [6] **D. Zhao**, J. Rocques, J. C. Little, and A. Hodgson (1999) "Effect of Reversible, Diffusion-Controlled Sinks on VOC Concentrations in Buildings" *Proc. of 8th International Conf. On IAQ&C*, Vol 5, 264-269. International Academy of Indoor Air Sciences, Edinburgh, Scotland, 8-13 August, 1999.
- [7] **D. Zhao**, A. K. SenGupta, and L. Stewart (1998) "A New Ion Exchange Process for Chromate Removal"

- Proc. of 30<sup>th</sup> Mid-Atlantic Ind. Haz. Waste Conf.*, Philadelphia, PA, July, 1998. R. P. S. Suri and G. L. Christensen, Eds., Technomic Publishing Co., 709-716.
- [8] **D. Zhao** and A. K. SenGupta (1997) "Selective Removals of Arsenate, Chromate, and Phosphate through Ion Exchangers" *Proc. of 58<sup>th</sup> Intern. Water Conf. (IWC)*, Pittsburgh, Nov 3-5, 1997, 564-570.
- [9] **D. Zhao** and A. K. SenGupta (1996) "Enhanced Removal and Recovery of Trace Contaminants through Polymeric Ligand Exchange" *Proc. of 28th Mid-Atlantic Ind. Haz. Waste Conf.*, Buffalo, NY, July, 1996. A. S. Weber, Ed., Technomic Publishing Co., 63-70.
- [10] **D. Zhao** and A. K. SenGupta (1995) "Toward Ultimate Removal and Recovery of Phosphate from Municipal and Industrial Wastewater" *Innov. Tech. for Site Remed. and Haz. Waste Mgmt., Proc. of The Natl. Conf.*, R. D. Vidic and F. G. Pohland (Eds.), American Society of Civil Engineers, 149-156.
- [11] **D. Zhao** and A. K. SenGupta (1995) "Selective Removal and Recovery of Phosphate from Wastewater" in *the 2nd Internat. Symp. on Wastewater Rec. and Reuse, Book I*, 211-219, IAWQ, Iraklio, Greece, Oct., 1995.

#### Extended Abstracts, Abstracts, and Presentations Since 2000

- [1] D. Zhao (2007) "Nanotechnologies for remediation of persistent organic pollutants in sediments and groundwater" Invited Panelist, the Geocongress 2008 conference, New Orleans during March 9-12, 2008. Abstract published.
- [2] Joo, S.H. and Zhao, D. (2007) "In-situ remediation of trichloroethylene in soil using stabilized Fe-Pd nanoparticles" 233rd American Chemical Society National Meeting *Chicago, IL. 25th-29th March, 2007*. Poster Presentation and abstract published.
- [3] He, F. and Zhao, D. (2007) "An Innovative Remediation Technology for in situ Destruction of Chlorinated Solvents in Soils and Groundwater Using a New Class of Soil-Dispersible Iron Nanoparticles" Poster Presentation, 2007 Water Resources Conference, Auburn University, June 13-15, 2007.
- [4] Xiong, Z., He, F., Zhao, D., Harper W. and Barnett, M.O. (2007) "In-situ Immobilization of Mercury in Sediment and Soil by A New Class of Stabilized Iron Sulfide Nanoparticles" Poster Presentation, 2007 Water Resources Conference, Auburn University, June 13-15, 2007.
- [5] Xiong, Z., He, F., Zhao D. (2007) "In-situ Mercury Immobilization in Soils and Sediment by Stabilized Iron Sulfide Nanoparticles" 21<sup>st</sup> Annual Alabama Water Resources Conference, September 5-7, 2007, Perdido Beach, AL.
- [6] He, F. and Zhao, D. (2007) "An innovative nanotechnology for in situ destruction of chlorinated solvents in soils and groundwater" 21<sup>st</sup> Annual Alabama Water Resources Conference, September 5-7, 2007, Perdido Beach, AL.
- [7] Xiong, Z., and Zhao, D. (2007) "Rapid Reduction of Concentrated Perchlorate and Nitrate in Water and Ion-Exchange Brine by Stabilized Iron Nanoparticles" The 2008 American Water Works Association Inorganic Contaminants Workshop, Albuquerque, NM, Jan. 27-29, 2008. Extended Abstract published.
- [8] A.D. Kney, P.S. Dimick, J. Tavakoli, S.E. Mylon, D. Zhao (2007) "A Comparison of Metal-Loaded DOW3N Ion Exchangers for Removal of Perchlorate from Water" 15th Symposium on Separation Science and Technology for Energy Applications, Gatlinburg, TN, Oct. 21-25, 2007. Paper published and oral presentation delivered.
- [9] D. Zhao, F. He, and C. Roberts (2007) "Stabilized zero-valent nanoparticles for rapid destruction of chlorinated hydrocarbons" Abstract published and oral presentation delivered, Interagency Workshop on the Environmental Implications, USEPA, Washington D.C., September 5-7, 2007.
- [10] Kanel, S. R.; Goswami, R. R.; Clement, T. P.; Barnett, M. O.; Zhao, D. (2008) "Transport of surface stabilized zero-valent iron nano particles in two-dimensional flow container packed with porous media" Preprints of Extended Abstracts presented at the ACS National Meeting, American Chemical Society, Division of Environmental Chemistry (2008), 48(1), 257.
- [11] Y. Xu, R. Liu, Z. Xiong, and D. Zhao (2007) "Synthesis and application of controllable nanoparticles for in situ immobilization of mercury, chromate and lead in soils, sediments and groundwater" Oral presentation and abstract published, AEESP Conference-Interactions at the Interface, Virginia Tech, July 28 - August 1, 2007.
- [12] J. Liu, F. He, D. Zhao and C. Roberts (2007) "synthesis of Pd nanoparticles exhibiting high catalytic

- activities for the hydrodechlorination of environmentally deleterious trichloroethylene” Oral presentation and abstract published, 11th Annual Green Chemistry and Engineering Conference, American Chemical Society, Washington D.C., June 26-29, 2007.
- [13] J. Liu, F. He, D. Zhao and C. Roberts (2007) "Green Synthesis Of Pd Nanoparticles For Catalytic Hydrodechlorination Of Environmentally Deleterious Trichloroethylene" AIChE's 2007 Annual Meeting, Salt Lake City Utah, Nov. 4 -9. Extended Abstract published and Oral Presentation delivered.
- [14] F. He and D. Zhao (2006) “Stabilization of Fe-Pd Nanoparticles with Polysaccharides for Enhanced Dechlorination of Trichloroethylene and Soil Transportability” Poster Presentation and abstract published, the 20th Annual Alabama Water Resources Conference, Orange Beach, AL, Sept. 6-8, 2006.
- [15] R. Liu and D. Zhao (2006) “In situ immobilization of lead in soils and groundwater by a new class of stabilized nano-particles” Poster Presentation and abstract published, the 20th Annual Alabama Water Resources Conference, Orange Beach, AL, Sept. 6-8, 2006.
- [16] Z. Xiong and D. Zhao (2006) “In situ immobilization of mercury in soils and sediments using a new class of iron sulfide nanoparticles” Poster Presentation and abstract published, the 20th Annual Alabama Water Resources Conference, Orange Beach, AL, Sept. 6-8, 2006.
- [17] Peter J. Bennett, Lester Feldman, Feng He and Dongye Zhao (2006) “Field Preparation and Testing of “Stabilized” Reactive Bi-Metallic Nanoparticles Composed of Iron and Palladium” Oral presentation and abstract published, The 16th Annual AEHS Meeting & West Coast Conference on Soils, Sediments and Water, 13 - 16 March, 2006.
- [18] S.H. Joo and D. Zhao (2006) “Degradation of Chlorinated Pesticides Using Stabilized Nanoscale Zero-Valent Iron Nanoparticles under Aerobic and Anaerobic Conditions” Oral presentation and abstract published, the 22nd Annual AEHS Conference on Soils, Sediments and Water at UMass, Amherst, October 16-19, 2006.
- [19] F. He and D. Zhao (2006) “Effects of Stabilizers and Synthesizing Conditions on the Reactivity and Transportability of Fe-Pd Nanoparticles for Enhanced Dechlorination of Trichloroethene in Water” Oral presentation and extended abstract published, 232th ACS National Meeting, San Francisco, CA, Sept 10-14, 2006.
- [20] Z. Xiong and D. Zhao (2006) “In situ immobilization mercury in soils using stabilized FeS Nanoparticles” Oral presentation and extended abstract published, 232th ACS National Meeting, San Francisco, CA, Sept 10-14, 2006.
- [21] Y. Xu and D. Zhao (2006) “Removal of lead from contaminated soil using polyamidoamine (PAMAM) dendrimers: column experiments and modeling” Oral presentation and extended abstract published, 231st ACS National Meeting, Atlanta, GA, March 26-30, 2006.
- [22] T. Steinwinder, B. An, D. Zhao, and M. O. Barnett (2006) “Stabilizing arsenic-laden residuals from ion exchange processes” Oral presentation and extended abstract published, 231st ACS National Meeting, Atlanta, GA, March 26-30, 2006.
- [23] R. Liu, D. Zhao, and M. O. Barnett (2006) “Influence of various soil compositions on the sorption of Cu(II) to soils and their effects on Cu(II) leachability and bioaccessibility” Poster presentation and extended abstract published, 231st ACS National Meeting, Atlanta, GA, March 26-30, 2006.
- [24] Z. Xiong and D. Zhao (2006) “Destruction of perchlorate in water and brine using stabilized zero-valent iron nanoparticles” Oral presentation and extended abstract published, 231st ACS National Meeting, Atlanta, GA, March 26-30, 2006.
- [25] F. He and D. Zhao (2006) “Application of a new class of polysaccharide-stabilized Fe-Pd nanoparticles for rapid destruction of chlorinated hydrocarbons in water” Oral presentation and abstract published, IWA World Water Congress and Exhibition, Beijing, 2006.
- [26] B. An, T. Steinwinder and D. Zhao (2006) “Selective removal of arsenate from drinking water using polymeric ligand exchangers” Oral presentation, IWA World Water Congress and Exhibition, Beijing, 2006.
- [27] T. Steinwinder and D. Zhao (2006) “Stabilization of As-laden waste residuals from ion exchange processes” Oral presentation, IWA World Water Congress and Exhibition, Beijing, 2006.
- [28] J.S. Arey, J. Snelling, M.O. Barnett, D. Zhao, K. Kawamoto, and P. M. Gschwend (2005) “Decision-making tools for anticipating the impacts of fuel blends on air and water: lessons from MTBE” Poster presentation with abstract published in proceedings, the 26<sup>th</sup> annual meeting of the Society of Environmental Toxicology and Chemistry, Baltimore, Maryland, November 13-17, 2005.

- [29] T. Steinwinder, B. An, D. Zhao, M. Barnett, and T. Kramer (2005) "Engineered Treatment of As-laden Regeneration Brine for Enhanced Stability of Process Waste Residuals" Poster Presentation and abstract published, the 19th Annual Alabama Water Resources Conference, Orange Beach, AL, Sept. 8-9, 2005.
- [30] Z. Xiong, F. He and D. Zhao (2005) "Complete Destruction of Perchlorate in Spent Regenerant Brine Using a New Class of Nanoscale Zero Valent Iron Particles" Poster Presentation and abstract published, the 19th Annual Alabama Water Resources Conference, Orange Beach, AL, Sept. 8-9, 2005.
- [31] F. He and D. Zhao "Development and Application of Novel Nano-materials and Nanotechnologies for Remediation of Contaminated Water, Soils and Sediments" Oral Presentation and abstract published, First AEESP Biennial Research and Education Conference, Clarkson University, Potsdam, NY, July 23-27, 2005.
- [32] P. Dimick, Z. Xiong, D. Zhao, A. Kney, J. Tavakoli (2005) "Sorption and Desorption of Perchlorate with a New Class of Polymeric Ligand Exchangers" 14<sup>th</sup> Symposium on Separation Sci. & Technol. for Energy Applications, Gatlinburg, TN, October 23-27, 2005.
- [33] B. An, T. Steinwinder, and D. Zhao (2005) "Selective Removal of Arsenate from Drinking Water Using a Polymeric Ligand Exchanger" Extended Abstract and Presentation, 230th ACS National Meeting, Aug 28-Sept 1, 2005, Washington, DC.
- [34] F. He and D. Zhao "Application of novel stabilizers for enhanced mobility and reactivity of iron-based nanoparticles for in-situ destruction of chlorinated hydrocarbons in soils" Extended Abstract and Presentation, 230th ACS National Meeting, Aug 28-Sept 1, 2005, Washington, DC.
- [35] T. Steinwinder, B. An, and D. Zhao (2005) "A Novel Ion exchange Process for Arsenic Removal from Drinking Water" 124th Annual Conference and Exposition, June 12-16, 2005, San Francisco, CA.
- [36] P. Dimick, D. Zhao, A. Kney, J. Tavakoli (2005) "Regeneration of a perchlorate loaded polymeric ligand exchanger, DOW 3N-Cu" AIChE 2005 Spring National Meeting, Atlanta, GA, April 10-14, 2005.
- [37] B. An and D. Zhao (2004) "Selective Removal of Arsenic from Drinking Water Using a New Class of Ion Exchangers" 2004 Alabama Water Resources Conference, Sept 8-10, 2004, Orange Beach, AL.
- [38] Z. Xiong and D. Zhao (2004) "Removal of Perchlorate from Drinking Water Using a New Class of Ion Exchangers" 2004 Alabama Water Resources Conference, Sept 8-10, 2004, Orange Beach, AL.
- [39] F. He and D. Zhao (2004) "Destruction of TCE and PCBs from groundwater and contaminated soils using a new class of highly reactive nanoscale particles" The 27<sup>th</sup> Annual Conference of Alabama's Water Environment Association, Perdido Beach, AL, April 25-28, 2004. (Oral)
- [40] F. He and D. Zhao (2004) "A novel remediation process for remediation of major Alabama sites contaminated with TCE and PCBs" Annual Alabama Groundwater Conference, Montgomery, AL, June 3, 2004.
- [41] Bevis, R. A., J. L. Subacz, J. Zhuang, M. O. Barnett, D. Zhao, M. A. Stewart and P. M. Jardine (2004). Reducing the bioavailability of Pb in soil. 20th International Conference on Soils, Sediments, and Water, October 18-21, Amherst, MA.
- [42] D. Zhao and J. C. Little (2003) "Modeling and experimental investigation of source/sink effects of polyurethane foam on indoor VOC concentrations", Healthy Buildings, 7th International Conference *Energy-Efficient Healthy Buildings* Singapore, December 7-11, 2003, Singapore (Oral)
- [43] R. Liu and D. Zhao (2003) "Fate and dynamics of copper applied to channel catfish ponds" Safe Water 2003, Atlanta, Oct 30-Nov 1, 2003. (Oral)
- [44] D. Zhao, J.C. Little, and S. Cox (2003) "Sorption/Desorption Behavior of Polyurethane Foam" *The 4th International Symp. on HVAC*, Beijing, China, Oct. 9-11 (Oral).
- [45] R. Liu and D. Zhao (2003) "Fate and speciation of copper in aquaculture ponds treated with copper sulfate" Annual Alabama Water Resources Research Conference, Orange Beach, AL, Sept. 3-5, 2003. (Oral)
- [46] Y. Xu and D. Zhao "Removal and recovery of heavy metals from contaminated soils using a new class of nano-scale sorbents" Annual Alabama Water Resources Research Conference, Orange Beach, AL, Sept. 3-5, 2003. (Oral)
- [47] E. D. Desormeaux and D. Zhao (2003) "Removal of atrazine using carbonaceous and polymeric sorbents: A comparative and mechanistic study" *Preprints of Extended Abstract*, American Chemical Society, Vol 43, No 2, 2003.
- [48] Y. Xu and D. Zhao (2003) "Remediation of metal-contaminated soils using a new class of nano-scale ion exchangers" *Preprints of Extended Abstract*, American Chemical Society, Vol 43, No 2, 2003.

- [49] D. Zhao and J. Pignatello (2003) "Model-aided characterization of Tenax for removal of aromatic compounds from water" American Chemical Society 225<sup>th</sup> National Meeting, New Orleans, LA, March 22-27, 2003.
- [50] D. Zhao (2003) "The environmental engineering program and its role in environmental protection" Poster presentation at the first annual Earth Day meeting, Auburn University Environmental Institute, April 21, 2003.
- [51] Kney, A.D. and D. Zhao (2002) "A Pilot Study-Phosphate and Nitrate Removal from Treated Domestic Wastewater using a Unique Enhanced Ion Exchange Process" CSCE/EWRI of ASCE Environmental Engineering Conference Proceeding, Niagara Fall, NY, July 2002.
- [52] D. Zhao (2002) "Enhanced removal and recovery of phosphate from water using a new ion exchanger" 25<sup>th</sup> Annual Conference of Alabama Water Environment Association, Orange Beach, AL. April 27-30, 2002.
- [53] D. Zhao (2001) "A new strategy for characterizing VOC emissions form building materials", the 2<sup>nd</sup> International Conference on Thermal Desorption, Birmingham, AL. Oct. 9-10, 2001.
- [54] A. K. SenGupta and D. Zhao (2001) "Synthesis and Characterization of Polymer-Anchored Copper(II) as a Reusable Selective Sorbent" AIChE Annual Meeting, Reno, Nevada, November 4-9, 2001.
- [55] D. Zhao, Pignatello JJ, White J (2000) "A Dual-mode diffusion model for non-linear sorption and desorption of hydrophobic contaminants in soils" *Extended ABSTRACTS OF PAPERS OF THE ACS*, 220: 111-ENVR Part 1. Oral presentation at the 220<sup>th</sup> ACS National Meeting, Washington D.C., 2000.
- [56] D. Zhao, J. Pignatello, J. White, M. Hunter (2000) "Dual-Mode Modeling of Competitive Sorption/Desorption of Polycyclic Aromatic Hydrocarbons in Soils and Sediments" presented at the 74th ACS Colloid and Surface Science Symposium, Lehigh University, Bethlehem, PA. June 19-21, 2000.
- [57] D. Zhao, J. White, M. Hunter, J. Pignatello (2000) "Influence of Bisolute Competition on the Physical and Biological Availability of PAHs in Natural Solids" Third SETAC World Congress & Tenth SETAC Europe Annual Meeting in Brighton, U.K, May 20-25, 2000.

#### Peer-reviewed Project Reports:

- [1] D. Zhao, B. An and T. Steinwinder (2006) A novel ion exchange process for selective removal of As(V) and for enhanced stability of process residuals, EPA Final Project Report.
- [2] D. Zhao and R. Liu (2005) Design Guidelines for Territorial wildlife and Fish Passage, Project Report to Highway Research Center, 98p.
- [3] D. Zhao and Y. Xu (2005) Evaluation of Best Management Practices for Controlling Runoff and Erosion at Transportation Construction Sites. Project report to Highway Research Center, 65p.
- [4] D. Zhao, T. Steinwinder, B. An, M. Barnett, and T Kramer (2005) "Developing a new class of ion exchangers for selective removal of arsenic and exploring an engineered approach for treatment and reuse of spent regenerant" Final project report to be published by the American Water Works Association, Denver, CO.

#### **INVITED PRESENTATIONS**

- [1] D. Zhao (2008) "Nanotechnologies for remediation of persistent organic pollutants in sediments and groundwater" Invited Panelist, the Geocongress 2008 conference, New Orleans during March 9-12, 2008. Abstract published.
- [2] D. Zhao (2007) "Preparation and application of stabilized nano-scale minerals for in situ immobilization of toxic metals in soils, sediments and solid wastes" Invited seminar, Stevens Institute of Technology, Center for Environmental Systems, Hoboken, NJ, Oct. 17, 2007.
- [3] D. Zhao (2007) "Application of novel nanoparticles for degradation of organic pollutants in water and soil" Invited seminar, State Key Laboratory of Organic Geochemistry, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Wushan, Guangzhou, China, April 10, 2007.
- [4] D. Zhao (2007) "Nanotechnologies for environmental remediation uses: History, Current State of technology and Prospects of Future Development" Invited seminar, Center for Eco-environmental Sciences, Chinese Academy of Sciences, Beijing, China, April 20, 2007.

- [5] D. Zhao (2007) “Nanotechnologies for environmental remediation uses: an overview” Invited seminar, Xi’an Jiao Tong University, Xi’an, Shanxi, China, April 7, 2007.
- [6] D. Zhao (2007) “Nanomaterials and nanotechnologies: Opportunities and Challenges for Environmental Engineering Professionals” Invited Seminar, Tsinghua University, Beijing, China.
- [7] Feng He, Yinhui Xu, R. Liu, and Dongye Zhao “Preparation and application of stabilized nanomaterials for environmental clean-up applications” July 2006, Invited Seminar, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing, China.
- [8] Feng He, Yinhui Xu, R. Liu, and Dongye Zhao “Preparation and application of stabilized nanomaterials for in situ immobilization of toxic metals in soils and groundwater” July 2006, Invited Seminar, Institute of Chemistry, Chinese Academy of Sciences, Beijing, China.
- [9] D. Zhao, Z. Xiong, M.O. Barnett and W. Harper (2006) “*In-situ* immobilization/containment of mercury in soils and sediments using a new class of stabilized metal sulfide nanoparticles”, invited seminar, EPA Region 4 Symposium on New Technologies for Site Remediation, February 28, 2006.
- [10] M.O. Barnett, D. Zhao, Z. Xiong, J. Bower and W. Harper (2006) “Immobilization of mercury in soils and sediments using metal sulfide minerals”, invited seminar, EPA Region 4 Symposium on New Technologies for Site Remediation, February 28, 2006.
- [11] D. Zhao (2002) “Mass transfer modeling of bioavailability, fate and transport of polycyclic aromatic hydrocarbons in soils and sediments”, invited seminar, Georgia Tech, October 23, 2002.
- [12] D. Zhao (2002) “Sorption and Bioavailability of Organic Contaminants in Soils”, invited seminar, Department of Soil and Agronomy, Auburn University. April 15, 2002.
- [13] D. Zhao (2001) “Competitive sorption and desorption of polycyclic aromatic hydrocarbons in estuarine sediments”, invited oral presentation at the 22<sup>nd</sup> Society of Environmental Toxicology and Chemistry (SETAC) Annual Meeting, Baltimore, MD, Nov. 11-15, 2001.
- [14] D. Zhao and J. Pignatello (2001) “Model-aided characterization of Tenax resins for sorption of aromatics from water”, invited poster presentation at the 22<sup>nd</sup> Society of Environmental Toxicology and Chemistry (SETAC) Annual Meeting, Baltimore, MD, Nov. 11-15, 2001.
- [15] D. Zhao and J. Pignatello (2001) “Dual-mode modeling of Competitive sorption and desorption of polycyclic aromatic hydrocarbons in soils and sediments”, invited seminar, Department of Chemical Engineering, Auburn University, Nov. 2, 2001.
- [16] D. Zhao (1999) “Impact of building materials on indoor air quality”, invited Speaker at the Quadrangle Conference, Virginia Tech, Blacksburg, VA, Feb. 1999.
- [17] D. Zhao and A.K. SenGupta (1997) “States of water molecules in polymeric sorbents and their roles in mass transfer kinetics”, invited poster presentation at the Gordon Research Conferences (Division of Adsorption and Reactive Polymers), Plymouth, NH, July, 1997.
- [18] D. Zhao (1997) “Mitigating the eutrophication problems using new ion exchange technologies”, invited co-speaker at the drinking water reservoir management workshop sponsored by the State of New York, Albany, NY, Jan. 1997
- [19] A.K. SenGupta and D. Zhao (1995) “Separation of trace contaminants through ligand exchange”, invited Presentation at the Gordon Research Conferences (Division of adsorption and Reactive Polymers), Newport, RI, July, 1995.

## HONORS AND AWARDS

- **Engineering Alumni Council Junior Faculty Research Award**, Auburn University, 2004.
- **Postdoctoral Research Fellowship Award**. Center for Indoor Air Research (CIAR), 1998.
- **ACS Graduate Student Award**. American Chemical Society (ACS), 1996.
- **Student Research Paper Award**. Pennsylvania Water Environment Ass. (PWEA), 1996.
- **Dean’s Graduate Fellowship Award**. Lehigh University, 1994.
- **Research featured in:** *College of Engineering Spring Magazine and Cupola Report (2008); AU Daily (May 1, 2008); AU College of Engineering Annual Report (2006); Research picture featured on the AU College of Engineering cover webpage (2006); AU Research News (1/06); Auburn University News (1/27/06); U.S. Water News (3/8/04); Columbus Ledger-Enquirer (2/15/06); Auburn University News (2/13/04); Mobile Register (5/2003); Montgomery Advertiser (6/1/03).*

- **Study Abroad Scholarship Award.** No. 1 in Taiyuan University of Technology, China, 1990.

Awards received by/with his students/postdocs:

Feng He	2008 ACS Best Graduate Paper Award, American Chemical Society
Sung Hee Joo	2007 ACS Young Chemist Award, American Chemical Society
Zhong Xiong	2007 Graduate Student Award in Environmental Chemistry, American Chemical Society
Feng He	2007 AWWA AL-MS Outstanding Graduate Student Scholarship Award
Feng He	2006 WEF-AL Branch Best Poster Award, 2 <sup>nd</sup> Place
Lucida Xu	2006 ACS Outstanding Paper Award of 231 <sup>st</sup> National Meeting, Division of Geochemistry
Lucida Xu	2006 Auburn University Outstanding International Graduate Student Award
Lucida Xu	2006 AWEA Outstanding Graduate Student Scholarship Award
Lucida Xu	2006 AWWA AL-MS Outstanding Graduate Student Scholarship Award
Thomas R. Steinwinder	2006 AU Top Ten Outstanding M.S. Students Award, Auburn University
Feng He	2006 Graduate Student Award in Environmental Chemistry, American Chemical Society
Zhong Xiong	Third Place Poster Presentation Award, Alabama Water Resources Research Conference, Orange Beach, AL, September 2005
Feng He	2005 Auburn-CH2M Hill Outstanding Ph.D. Student Award
Lucida Xu	2004 Auburn-CH2M Hill Outstanding Ph.D. Student Award
Byungryul An	2004 Albert and Julia Smith Graduate Scholarship Award

#### STUDENT ADVISING

**As Major Advisor** (Total: 3 Postdoc; 6 Ph.D. (4 graduated), 7 MS Students (6 graduated), 2 undergraduate students)

**As Committee Member** (Total: 10 Ph.D. students; 15 M.S. students)

#### ACADEMIC AND PROFESSIONAL ACTIVITIES

- **Journal and Book Reviewer:**  
ES&T; Ind. & Eng. Chem. Res.; Reac. & Functional Polymer; Colloid & Surfaces; Current Anal Chem; JAWWA; JEQ; JEM; Ach. Environ. Contam. Tox.; Int. J. of Heat Mass Trans; WER; Book reviewer for Prentice Hall.
- **Proposal Reviewer/panel:**  
NSF; US DOE; SERDP; ACS Petroleum Res. Fund; U.S. Civilian R&D Foundation (CRDF) Panel.
- Served as **session chair** at 25<sup>th</sup> Annual Conference of Alabama Water Environment Association, Orange Beach, AL. April 27-30, 2002.
- Served as **session chair** at the International Conference "Safe Water 2003, Atlanta, Oct 30-Nov 1, 2003.
- Serving on the **Publication Committee** for the Association of Environmental Engineering and Science Professors (AEESP) since July, 2006.

#### COURSES TAUGHT

- CIVL3230: Introduction to Environmental Engineering (Undergraduate, 4 credit hrs), AU.
- CIVL7220/7226: Water & Wastewater I (Reaction Kinetics, Reactor Analysis, Modeling Principles) (Graduate, 3 credit hrs), AU.
- CIVL7220/7226: Water & Wastewater II (Physical chemical processes for water and wastewater treatment) (Graduate, 3 credit hrs), AU.
- CIVL3210: Environmental Engineering I (Water Treatment) (Undergraduate, 3 credit hrs), AU.
- CEE5794: Environmental Engineering Principles (Graduate, with Dr. Little), Virginia Tech., Fall 1998.
- ChEM206, Environmental Organic Chemistry, Teikyo Post University, Waterbury, CT. (Undergraduate, 3 hrs), Fall 2000.

#### OTHER SERVICES

- Serving as the Graduate Student Coordinator for the Environmental Program, AU.

- Lead Initiation of a 12-month MCE program in environmental engineering at AU.
- Served the Departmental Committee on FE exam and CE curriculum.

## RESEARCH GRANTS AND PROJECTS

### Before AU:

- [1] **D. Zhao (PI)** “Mass transfer modeling of VOCs in indoor air” \$60,000; Postdoctoral Research Fellowship, Center for Indoor Air Research (CIAR), 1998-2000. (Received at Virginia Tech)

### After AU:

- [1] **D. Zhao (PD)** and Yucheng Feng (Soil and Agronomy) “Reducing the leachability of phosphate and arsenic from poultry litter using a new class of iron (hydr)oxide nanoparticles” \$97,865; Alabama Agricultural Experiment Station, 10/01/2007-09/30/2008.
- [2] **D. Zhao (PD)**, Mark Barnett, and Tim Kramer (Texas A&M) “Pilot-Testing an Innovative Ion Exchange Process for Highly Selective and Regenerative Arsenic Removal and an Engineered Approach for Stabilizing Arsenic-Laden Process Waste Residuals” \$266,735; American Water Works Association Research Foundation (AwwaRF), 05/01/2006-04/30/2008.
- [3] **D. Zhao (PD)** “A Preliminary Pilot-Test of a New Class of Dispersible and Reactive Nanoscale Zero-Valent Iron Particles for in-situ Destruction of Perchloroethylene (PCE) at a California Site” \$50,000; Geomatrix Consultants, Oakland, CA; 02/01/2006-05/31/2006.
- [4] **D. Zhao (PD)** “Pilot-Testing an Innovative Remediation Technology for in-situ Destruction of Chlorinated Organic Contaminants in Alabama Soils and Groundwater using a New Class of Zero Valent Iron Nanoparticles” \$50,001; USGS-Alabama Water Resources Research Institute; 03/01/2006-02/29/2007.
- [5] **D. Zhao (PD)** and C. Roberts “Synthesis and Application of a New Class of Stabilized Nanoscale Iron Particles for Rapid Destruction of Chlorinated Hydrocarbons in Soil and Groundwater” \$280,215; U.S. EPA; 08/01/2005-07/31/2008.
- [6] **D. Zhao (PD)**, W. Harper, and M. Barnett “Development and Application of an Innovative Nanotechnology for in-situ Remediation of Mercury-Contaminated Alabama Soils and Sediments” \$75,103; USGS-Alabama Water Resources Research Institute; March 1 2005-Feb 29, 2006.
- [7] Z. Cheng, T. Huang, and **D. Zhao (Co-PI)** “Detection of E. COLI In source Water using a novel biosensor” \$74,984; USGS-Alabama Water Resources Research Institute; March 1 2005-Feb 29, 2006.
- [8] **D. Zhao (PD)**, Mark Barnett, and Tim Kramer (Texas A&M) “Developing a new class of ion exchangers for selective removal of arsenic and exploring an engineered approach for treatment and reuse of spent regenerant” \$148,074; American Water Works Association Research Foundation (AwwaRF), June 15, 2004-June 14, 2005.
- [9] **D. Zhao (PD)**, A. McClain and W. Harper “Development and characterization of a new class of high-capacity ion exchangers and an environmentally benign process for removal and destruction of perchlorate in water” \$50,029; USGS-Alabama Water Resources Research Institute; March 1 2004-Feb 29, 2005.
- [10] **D. Zhao (PD)** and M. Barnett “A novel ion exchange process for selective removal of As(V) and for enhanced stability of process residuals” \$99,452; NSF/EPA Joint Program for the Environment: New Technology for the Environment (NTE), Nov. 1, 2003-Oct. 31, 2005.
- [11] **D. Zhao (PD)**, C. Lange and M. Barnett “In-situ destruction of PCBs, PCE and TCE in Alabama soils and groundwater using a new nanoscale sorptive catalyst” \$49,902; USGS-Alabama Water Resources Research Institute; March 1 2003-Feb 29, 2004.
- [12] M. Barnett and **D. Zhao (Co-PI)** “Decreasing toxic metal bioavailability with novel soil amendment strategies” \$376,745; Oak Ridge National Laboratory (sponsored by US DoD); Mar. 2003-Feb. 2006.
- [13] **D. Zhao (PD)**, Claude Boyd, and Mark Barnett “Retention of Copper in Sediment of Aquaculture Ponds Treated with Copper Sulfate” \$80,000; Auburn University Environmental Institute; April 2002-March 2004.
- [14] **D. Zhao (PD)** “Evaluation of the best management practices for mitigating impacts of transportation projects on Stream and wildlife ecology” \$53,800; Alabama DOT via Highway Research Center, Auburn

University; May 2002-April 2004.

- [15] **D. Zhao (PD)** “Evaluation of Best management practices for controlling runoff and erosions at transportation construction sites” \$28,699; Alabama DOT via Highway Research Center, Auburn University; Jan 2003-Dec 2003.
- [16] **D. Zhao (PD)** “Selective removal of odorants and pesticides from wastewater through polymeric ligand exchange” \$4000; AU Faculty Mentoring Program; Feb, 2002-Jan. 2003.
- [17] **D. Zhao (PD)** “In-situ immobilization of toxic metals in soils using functional nanoparticles” \$10,000; AU Competitive Research Grants; May 2002 – April 2003.
- [18] **D. Zhao (PD)** and Cliff Lange “Application of Novel Nanoparticles for Remediation of Soils and Groundwater Contaminated with Toxic Metals” \$20,000; College of Engineering Competitive GRA Program; Oct. 2002 – Sept. 2004.