

INSTITUTE FOR CLEAN ENERGY TECHNOLOGY
(formerly Diagnostic Instrumentation and Analysis Laboratory)
Bagley College of Engineering, Mississippi State University

Annual Report to the Vice President for Research
for the period July 1, 2005 - June 30, 2006

Description and Purpose

The Institute for Clean Energy Technology has been established in the Bagley College of Engineering to be Mississippi State University's research institute to serve as a bridge between basic science and large-scale engineering applications for sustainable energy systems. The Institute will focus its research on process efficiency, resource recovery, and life-cycle impact. Research results and partnerships with industry will be designed to enhance economic development.

As recorded in the January 19, 2006 minutes of the Board of Directors of the Institutions of Higher Learning, MSU is renaming the Diagnostic Instrumentation and Analysis Laboratory to the Institute for Clean Energy Technology in order to reflect the change in scope of the unit's mission. This change to the limited scope and outreach unit is in response to Mississippi State's increased research efforts in the area of energy systems. As the Bagley College of Engineering moves forward to support the University's strategy, careful examination brought the Diagnostic Instrumentation and Analysis Laboratory, the new Center for Advanced Portable Power Technology and Manufacturing, and the Fuel Cell Research Laboratory, previously housed in the Center for Advanced Vehicular Systems, together to support University research in clean energy. This synergy will serve as the catalyst for the University's research for hydrogen economy and for the clean use of other forms of energy. The Institute will have four research thrusts focused on characterization, process engineering and development, production and storage, and environmental mediation.

The Institute for Clean Energy Technology (ICET) builds on and continues the thirty-year tradition of excellence in engineering research established by the Diagnostic Instrumentation and Analysis Laboratory (DIAL). Prior to 1993, the majority of its funding was from the Office of Technology Development within the Office of Environmental Management of the U.S. Department of Energy (DOE). Since then, a vigorous diversification program has been established with sponsors from other branches of government including the Department of Defense (DOD), Department of Homeland Security (DHS), NASA, DOE-Fossil Energy, and EPA, along with specific industrial partners and consortia.

ICET is an interdisciplinary research department in the Bagley College of Engineering. A number of the professionals hold joint appointments in academic departments in the Bagley College of Engineering and the College of Arts and Sciences. ICET has the distinction of being the longest continuously funded research program in the College of Engineering with funding in excess of \$100 million dollars since 1976. ICET is among the leaders at MSU in the development of intellectual property with more than 30 patents and licenses applied for by the staff to date. Since 1976, ICET has supported more than 450 students who were seek-

ing masters and doctoral degrees.

The ICET facility is a 58,000-square-foot, state-of-the-art building located on eight acres in the Thad Cochran Research Park. The facility consists of 41 faculty and administrative offices, one classroom, a 75-seat auditorium, a machine shop, a high-bay test area, 16 research laboratories, and numerous graduate student offices. Funding for this facility was provided through a grant from the Department of Energy and with matching funds from the State of Mississippi.

Program Impacts

Our research project on *Bioavailability of Hg in Oak Ridge Ecosystem* has made excellent progress this year. Our study found that planting increased the solubility and bioavailability of HgS form in Oak Ridge soils. This finding could explain why the current Hg level in both fish and water of the creek around Oak Ridge has increased recently in spite of the fact that Hg in flood plains of Oak Ridge are mostly in HgS form. We will continue in this pioneering research and develop our understanding of the mechanism of the current mercury situation at Oak Ridge. This will provide the Department of Energy with the basic knowledge for developing a cost-effective remediation strategy.

Oak Ridge National Laboratory (ORNL) is currently re-inventing itself by developing world-class facilities in a number of areas. In order to do this, some of the existing buildings have to be demolished so that new facilities can be built. One of the facilities to be demolished (but not until at least 2009) is the *Oak Ridge Research Reactor*. The Oak Ridge Research Reactor (ORRR) was designed and operated as an isotope production and irradiation facility at the Oak Ridge National Laboratory (ORNL) from March 1958 until March 1987. In July 1987, the Department of Energy (DOE) permanently shut down the ORRR. The decision to shut down the ORRR required placing the reactor in a safe configuration until final decommissioning could be accomplished. Removal of all fuel and fuel-bearing components was completed in July 1989; however, several irradiated reactor components were left in the pool until such time as they could be safely removed (at the time of D&D). Hazardous chemicals and equipment associated with past operations were also removed. Processes and procedures have been established to maintain a safe and stable condition pending final disposition.

The water level in the reactor pool is maintained to provide shielding for several irradiated reactor components that still remain in the pool. The reactor pool is approximately 60 feet long (which runs east-to-west), 11 feet wide (which runs north-to-south), and 30 feet deep, and contains about 125,000 gallons of water. The pool is constructed of reinforced concrete with one-quarter inch thick aluminum plates welded to aluminum structures embedded in the concrete. Building surveillance and maintenance personnel have observed a noticeable increase in the accumulation of white aluminum oxide in the reactor pool since the water treatment system change in 2001. Pit corrosion is a localized form of corrosion. A visual inspection of the pool in February 2004 by facility management observed numerous points of corrosion on the south wall of the center pool section.

Although the extent of the aluminum oxide build-up can be observed, the depth of the corro-

sion and the potential threat to the integrity of the liner is unknown. Further testing is needed to understand the corrosion rate and extent of oxidation occurring in the pool. Mississippi State University's Diagnostic Instrumentation and Analysis Laboratory (DIAL) has developed and, in collaboration with DOE EM, deployed a submergible Fourier transform profilometry system to characterize the pit corrosion. The ORNL contacted DIAL in July 2005 with a request to develop and deploy a quantitative imaging system to characterize the pit corrosion to ascertain the integrity of the aluminum liner. The DIAL submergible Fourier transform profilometry (FTP) system was first deployed into the ORRR pool in December 2005. The DIAL FTP system successfully measured the volume of corrosion materials. The FTP system will again be deployed into the ORRR pool during late summer 2006 for more extensive characterization.

Proposals Submitted - 43

PI	Title	Source	Amount
Miller Singh Yueh	Stand-off explosive detection using a compact, portable, integrated laser induced breakdown spectroscopy and Raman spectroscopy system	CAEC, LLC	24,708
Fanguy	Catastrophic flood sensor for submerged oceanographic vessel	Planning Systems	1,946
Miller Patterson Singh	Evaluation of a thermal treatment process for recycling alkaline batteries	General Environmental Management, Inc.	9,997
Arunkumar Norton	Underground coal gasification as a novel SNG/electricity co-production process	Clean Coal, LLC	52,047
Wang	Laser system for diagnostic instrumentation and sensor development	US DOD	226,320
Palmer	Nuclear energy research initiative program	Energy Research Initiative Program	190,046
Singh	Non-intrusive concentration measurement of metallic species in a hydrocarbon rocket engine exhaust	CAEC, LLC	23,311
Singh	Hydrocarbon rocket engine plume diagnostic by laser induced incandescence	CAEC, LLC	23,311
Singh	Study of hot hydrocarbon dissociation in a nuclear thermal rocket	CAEC, LLC	59,566
Singh	Measurement of free atom fraction in a hydrocarbon rocket engine exhaust	CAEC, LLC	59,744
Singh	Hydrocarbon rocket engine plume imaging with laser induced incandescence	CAEC, LLC	60,000
Singh	Non-intrusive, on-line species concentration measurement of a hydrocarbon rocket engine	CAEC, LLC	59,566
Singh	Non-intrusive multi-point detection of nitrogen in a hydrocarbon rocket engine feed line	MS Ethanol	59,566
Singh	Species concentration of hot hydrogen dissociation in nuclear thermal rocket (NTR)	CAEC, LLC	23,310
Singh	In situ, non-intrusive detection of nitrogen in RP-1 fuel rocket engine feed line	MS Ethanol	23,310
Singh	In situ, non-intrusive, species concentration measurement in a hydrocarbon rocket engine combustion	CAEC, LLC	23,310
Wang	Portable cavity ringdown spectrometer	US DOE	90,000
Wang	Development of sol-gel processes for preparing homogeneous solid standard materials for direct solid sample	US DOC	296,099

PI	Title	Source	Amount
	analysis		
King, et al	US DOE Cooperative Agreement	US DOE	25,000,000
Lindner Luthe Wang	Laser atmospheric propagation screening system (LAPSS)	Ocean Systems Engineering Group	42,970
Lindner	Standoff detection of improvised explosive devices	Ocean Systems Engineering Group	62,100
Singh	Effect of fatty acid methyl esters on flame propagation dynamics in NOx emissions behavior of biodiesel fuels	NSF	193,589
Han Su	Evaluate and apply three cost-effective remediation technologies for clean-up of post-Katrina watersheds of US Gulf Coast area	NSF	383,387
Singh	Integrated optical-nanosystems for DNA hybridization and biomedical application	Jackson State University	320,027
Singh	Unraveling the reaction pathway in the formation of nano-crystalline diamond film using different inert gases	Jackson State University	230,062
Lindner Monts	Advanced detection of improvised explosive devices (IEDs)	B.E. Meyers & Co., Inc.	33,331
Younan	Fellowships in applied physics, electrical engineering and computer engineering	US DOEd	27,881
Tao	Sol-gel chemistry for preparing solid matrix-matched radioactive standards for LA-ICP-AES/MS	US DOE	1,159,261
Singh	Non-intrusive, real time, on-line temperature sensor for superheated hydrogen at high pressure and high flow	CAEC, LLC	343,776
Wang	Collaborative proposal — characterization of low energy electron beam plasma	SUNY-Syracuse	150,206
Tao	Selective optical fiber NOx sensors for on-board long-term monitoring in auto vehicle emission control	US DOE	213,542
Wang	Development of portable breath analyzer for diabetes diagnostics	Metabolic Solutions, Inc.	59,893
Waggoner	Technical assistance for the locating and retrieving of expended depleted uranium munitions	US Army Corp of Engineers, DOD	1,675,000
Singh	Chemotherapeutic resistance and heterogeneity of breast cancer cells: novel methods of detection and assessment	US DOD	210,335
Rogers	Investigation of radionuclide retention by emulsions	US Army Corp of Engineers, DOD	27,500
Wang	Development of broadband, open-slot plasma source-cavity ringdown spectrometer for in situ quantifying/monitoring trace radionuclides, metals radionuclides	LANL DOE	499,822
Tao	Development of unique scintillating optical fiber sensors and sensor array for in situ subsurface radioactive contaminants monitoring	LANL DOE	528,143
Tao	Fiber optic sensors for selective on-line, real time monitoring of syngas composition in clean coal technology by using sol-gel derived nanocomposition	US DOE	100,000
Jang Monts	Real-time imaging fusion techniques for a multiple-camera fireball location system for optimization of coal-fired furnace performance	US DOE	200,000
Norton	Foamed glass material with extremely high water uptake and retention properties for hydroponic agriculture applications	Earthstone International, LLC	33,000

Awards and Active Projects - \$7,707,409

PI	Title	Source	Type \$\$	Total \$\$ FY 05-06
Wang	Peroxy CRDS	SUNY-Syracuse	Federal	58,234
Fanguy	Catastrophic flood sensor for submerged oceanographic vessel	Planning Systems	Private	1,955
Fanguy Tao Giordana	Optical fiber chemical sensor with sol-gel derived refractive material as transducer for high temperature gas sensing in clean coal technology	US DOE	Federal	166,323
Miller Patterson Singh	Evaluation of a thermal treatment process for recycling alkaline batteries	General Environmental Management, Inc.	Private	9,997
King, et al	Accelerating cleanup of the defense nuclear legacy	US DOE	Federal	6,806,379
Lindner Wang	DIAL MMU support for SECARB Phase II	Southern States Energy Board	Federal	75,001
Singh Yueh	NASA-STTR Phase II	MS Ethanol	Federal	303,327
Smith	Development and testing of unique radiation detection technology and particle size distribution	LANL-DOE	Federal	15,000
Wang	Portable cavity ringdown spectrometer	US DOE	Federal	90,000
Lindner Monts	Standoff detection of improvised explosive devices	Ocean Systems Engineering Group	Federal	121,194
Singh	Hydrocarbon rocket engine plume imaging with laser induced incandescence	CAEC, LLC	Federal	59,999

Student Involvement - Personnel by Degrees

1 Post-doctoral
 10 Doctoral
 3 Masters
 3 Undergraduate
 1 Mississippi School for Math and Science

Collaborations - Scientists

Oak Ridge National Lab

Dr. Tuan Vo-Dinh
 Dr. Thomas Thundat
 Dr. Madhvi Martin

Army Research Lab

Dr. Andrzej Miziolek

Jackson State University

Dr. Paresh Ray

Mississippi State University

Dr. C. F. Su, Physics

Dr. Phil Steel, Forest Product Laboratory

Dr. San Fernando, Agriculture and Biological Engineering

Dr. Thomas Philip, Computer Science and Engineering

Dr. Scott Willard, Agriculture and Dairy Science

Dr. Shane Burgess, College of Veterinary Science

Dr. Susan Diehl, Department of Forest Products

Dr. Hamid Borazjani, Department of Forest Products

Dr. Yul Chu, Department of Electrical and Computer Engineering

Collaborations - Universities

Jackson State University

Tuskegee University

Major Awards and Recognitions

Dr. Fengxiang Han serves on the Editorial Board of *Water, Air, and Soil Pollution* and also of *Water, Air, and Soil Pollution: Focus*. He also serves as co-chair of the Environmental Science Working Group of the Bagley College of Engineering at Mississippi State University.

Dr. Jagdish P. Singh was awarded funds to arrange an Indo-US Workshop on Recent Trends in Spectroscopy: Application to National Security (www.indousspectroscopy.org) by the Indo-US Science and Technology Forum (www.indoustf.org). He was selected a Fellow of the Laser and Spectroscopy Society of India (LASSI). He served the Optical Society of America as a reviewer of papers and arranged a topical meeting on Laser Applications to Chemical Security Environmental Analysis (LACSEA). He also reviewed papers and arranged a session at the Optics East Conference for the SPIE-International Society for Optical Engineering. Dr. Singh reviewed papers for *Applied Optics*, *Applied Physics*, *Spectrochim Acta B* and the *Journal of Science and Technology*. He gave an invited talk on Laser-based Optical Fiber Probes for Biomedical Application at the Institute of Medical Sciences, Banaras Hindu University, Varanasi, India in January 14, 2006. Invited seminars at Mississippi State University included the Departments of Physics, Biological Sciences and LSBI.

Book Chapters - 4

M.V. Naugle and C.A. Waggoner. 2005. Asbestos. Chapter in *Hazardous Materials Management Desk Reference, Second Edition*. Academy of Certified Hazardous Materials Managers, Rockville, MD, pp. 433-456.

J.E. Milner and C.A. Waggoner. 2005. Brownfields. Chapter in *Hazardous Materials Management Desk Reference, Second Edition*. Academy of Certified Hazardous Materials Man-

agers, Rockville, MD, pp. 335-362.

J.P. Singh and Fang-Yu Yueh, et al. 2005. Environmental contamination and military applications of LIBS. Chapter in *Laser-induced Breakdown Spectroscopy (LIBS): Fundamentals and Applications*, A. Miziolek, V. Palleschi and I. Schechter, eds. Cambridge University Press.

Shiquan Tao. Fiber optic chemical sensors for environmental monitoring. Chapter in *Encyclopedia of Sensors* (the first encyclopedia of sensors).

Refereed Publications - 17

F.X. Han, W.D. Patterson, Y. Xia, B.B.M. Sridhar and Y. Su. 2006. Rapid determination of mercury in plant and soil samples using inductively coupled plasma atomic emission spectroscopy, a comparative study. *Water, Air and Soil Pollution* 170:161-171.

S.K. Khijwania, K.L. Shrinivasan and J.P. Singh. 2005. An evanescent-wave optical fiber relative humidity sensor with enhanced sensitivity. *Sensors and Actuators B*, 104:217-222.

S.K. Khijwania, K.L. Shrinivasan and J.P. Singh. 2005. Performance optimized optical fiber sensor for humidity measurement. *Optical Engineering* 44:034401-1-7.

Chan Kyu Kim, Rajamohan R. Kalluru, Jagdish P. Singh, Angela Fortner, Jelani Griffin, Gopala K. Darbha and Paresh C. Ray. 2006. Gold nanoparticle based miniaturized laser induced fluorescence probe for specific DNA hybridization detection: studies on size dependent optical properties. *Nanotechnology* 17:3085.

B. Lal, F.Y. Yueh and J.P. Singh. 2005. Glass-batch composition monitoring by laser-induced breakdown spectroscopy. *Applied Optics* 44:3368-3674.

Z.P. Li, T.L. Zhang, F.X. Han and P. Felix-Henningsen. 2005. Changes in soil C and N contents and mineralization across a cultivation chronosequence of paddy fields in subtropical China. *Pedosphere* 15:5:554-562.

Z.P. Li, T.L. Zhang, D.C. Li, B. Velde and F.X. Han. 2005. Changes in soil properties of paddy fields across a cultivation chronosequence in subtropic China. *Pedosphere* 15:1:110-119.

S.J. Mechery and J.P. Singh. 2006. Fiber optic based gas sensor with nano porous structure for the selective detection of NO₂ in air samples. *Analytica Chimica Acta* 557:123-129.

D.H. Pote, W.L. Kingery, G.E. Aiken, F.X. Han and P.A. Moore, Jr. 2006. Incorporating granular inorganic fertilizer into perennial grassland soils to improve water quality. *Journal of Soil and Water Conservation* 61:1:1-7.

V.N. Rai, F.Y. Yueh and J.P. Singh. 2005. Optical emission from laser-produced chromium

and magnesium plasma under the effect of two sequential laser pulses. *Pramana-Journal of Physics* 65:1075-1083.

P.C. Ray, A. Fortner, J. Griffin, C.K. Kim, J.P. Singh and H. Yu. 2005. Laser-induced fluorescence quenching of tagged oligonucleotide probes by gold nanoparticles. *Chemical Physics Letters* 414:259-264.

B.B.M. Sridhar, S.V. Diehl, F.X. Han, D.L. Monts and Y. Su. September 2005. Anatomical changes due to uptake and accumulation of zinc and cadmium in Indian mustard (*Brassica juncea*). *Environmental and Experimental Botany* 54:2:131-141.

Y. Su, F.X. Han, B.B. Maruthi Sridhar and D.L. Monts. 2005. Phytotoxicity and phytoaccumulation of trivalent and hexavalent chromium in brake fern. *Environmental Toxicology and Chemistry* 24:8:2019-2026.

S. Tao, J.C. Fanguy and L. Xu. 2006. Optical fiber ammonia sensing probes using reagent immobilized porous silica coating as transducers. *Sensors and Actuators, B: Chemistry* B115:158.

S. Tao and T.V.S. Sarma. 2006. An evanescent wave optical Cr(VI) sensor using a flexible fused silica capillary as a transducer. *Optics Letters* 31:1423.

R.K. Toghiani, V. Phillips and J.S. Lindner. 2005. Solubility in the Na-F-SO₄-OH system. *Journal of Chemical and Engineering Data* 1616-1619.

R. Venkatraman, P.C. Ray, F.R. Fronczek and J.P. Singh. 2005. Structure and nonlinear optical properties of the HMT-CDA 1:1 adduct: experimental and DFT approach. *International Journal of Quantum Chemistry* 105:446-452.

Non-refereed Publications - Reports

Ping-Rey Jang, R. Arunkumar, Zhiling Long, Melissa Mott, Walter P. Okhuysen and David L. Monts. February 2006. *Fourier transform profilometry (FTP) aluminum liner pit corrosion measurements in Oak Ridge Research Reactor (ORRR) pool, Oak Ridge National Laboratory (ORNL), Oak Ridge, TN 37831, December 8 - 9, 2005*. Trip Report. Submitted to Oak Ridge National Laboratory.

M.J. Plodinec and DIAL Research Professionals. July 2005. *Accelerating cleanup of the defense nuclear legacy*. Report No. 07029R01. Quarterly Technical Progress Report for the period April — June 2005. Diagnostic Instrumentation and Analysis Laboratory, Mississippi State University.

Roger King and DIAL Research Professionals. October 2005. *Accelerating cleanup of the defense nuclear legacy*. Report No. 07029R02. Quarterly Technical Progress Report for the period July — September 2005. Diagnostic Instrumentation and Analysis Laboratory, Mississippi State University.

Roger King and DIAL Research Professionals. January 2006. *Accelerating cleanup of the defense nuclear legacy*. Report No. 07029R03. Quarterly Technical Progress Report for the period October — December 2005. Diagnostic Instrumentation and Analysis Laboratory, Mississippi State University.

Roger King and ICET Research Professionals. April 2006. *Accelerating cleanup of the defense nuclear legacy*. Report No. 070240R01. Quarterly Technical Progress Report for the period January — March 2006. Institute for Clean Energy Technology, Mississippi State University.

D.L. Monts and J.S. Lindner. July 2005. *Spectroscopic options for improvised explosive device remote detection*. Report submitted to Ocean Systems Engineering Corporation as part of SBIR Phase I grant.

O.P. Norton and R.A. Palmer. December 2005. *Technology to support the design of a nuclear propulsion and power non-nuclear (NP2N) test facility*. Final Report, Award Number USMMRCSSC 032820051 05090889. Contract report submitted to NASA.

O.P. Norton and R.A. Palmer. February 2006. *Technology to support the design of a nuclear propulsion and power non-nuclear (NP2N) test facility*. Addendum to Final Report, Award Number USMMRCSSC 032820051 05090889. Contract report submitted to NASA.

O.P. Norton, R.A. Palmer and W.G. Ramsey. November 2005. *Enhancement of structural foam materials by incorporation of gasifier slag*. Semi-annual Progress Report, Award Number DE-FC26-04NT42204. Contract report submitted to DOE.

O.P. Norton, R.A. Palmer and W.G. Ramsey. December 2005. *Enhancement of structural foam materials by incorporation of gasifier slag*. Semi-annual Progress Report, Award Number DE-FC26-04NT42204. Contract report submitted to DOE.

O.P. Norton, R.A. Palmer and W.G. Ramsey. March 2006. *Enhancement of structural foam materials by incorporation of gasifier slag*. Final Scientific/Technical Report, Award Number DE-FC26-04NT42204. Contract report submitted to DOE.

J.P. Singh and F.Y. Yueh. November 2005. *Real-time non-intrusive detection of liquid nitrogen in liquid oxygen at high pressure and high flow*. NASA/SSC-STTR Project Report. NASA Contract No. NNS05AB02C.

J.P. Singh, F.Y. Yueh and R.L. Cook. January 2006. *Non-intrusive, real-time, on-line temperature sensor for superheated hydrogen at high pressure and high flow*. NASA-STTR Phase I Final Report, Contract No. NNS05AA41C. Diagnostic Instrumentation and Analysis Laboratory, Mississippi State University.

J.P. Singh and F.Y. Yueh. November 2005. *Non-intrusive, real-time, on-line temperature sensor for superheated hydrogen at high pressure and high flow*. NASA/SSC-STTR Bi-monthly Reports, Contract No. NNS05AA41C.

J.P. Singh and F.Y. Yueh. September 2005. *Non-intrusive, real-time, on-line temperature sensor for superheated hydrogen at high pressure and high flow*. NASA/SSC-STTR Bi-monthly Reports, Contract No. NNS05AA41C.

J.P. Singh and F.Y. Yueh. July 2005. *Non-intrusive, real-time, on-line temperature sensor for superheated hydrogen at high pressure and high flow*. NASA/SSC-STTR Bi-monthly Reports, Contract No. NNS05AA41C.

M.S. Parsons and C.A. Waggoner. January 2006. *Emergency Planning Resource Guide, Versions 1.0, 1.1, 2.0, 2.1 and 3.0*. A series of proprietary documents produced as part of the Highway Watch² Program (HWW), under Cooperative Agreement HSTS04-04-H-STR001 between the American Trucking Associations, Inc. (ATA) and the U.S. Department of Homeland Security (DHS), Office of Domestic Preparedness (ODP). Mississippi State University (MSU), as administrator of the HWW Emergency Planning and Education Center (EPEC) under a subcontract to ATA, was principal author of this document.

Presentations and Proceedings

Steven Alderman, R. Arunkumar, John Etheridge, John Luthe, Brian Nagel, Olin Norton, Michael Parsons, Donna Rogers, Kristina Hogancamp and Charles Waggoner. February 2006. *Lifetime testing of sintered metal and ceramic membrane regenerable filter media*. Waste Management Symposium, Tucson, AZ.

Steven Alderman, R. Arunkumar, John Etheridge, John Luthe, Brian Nagel, Olin Norton, Michael Parsons, Donna Rogers, Kristina Hogancamp and Charles Waggoner. February 2006. *Evaluation of glass fiber HEPA filters as a function of media velocity*. Waste Management Symposium, Tucson, AZ.

S. Alderman, B. Nagel, M. Parsons, D. Rogers, K. Hogancamp and C. Waggoner. May 2006. *Evaluation of glass fiber HEPA filters as a function of media velocity*. Proceedings of the 2006 International Conference on Incineration and Thermal Treatment Technologies, Savannah, GA.

S. Alderman, B. Nagel, M. Parsons, D. Rogers, K. Hogancamp and C. Waggoner. June 2006. *Evaluation of glass fiber HEPA filters as a function of media velocity*. Proceedings of the 29th Air Cleaning Conference, Cincinnati, OH.

J. Fanguy and S. Tao. September 2005. *A highly sensitive sol-gel silica optical fiber sensor for monitoring of trace ammonia in high temperature gas samples*. Proceedings of 22nd International Pittsburgh Coal Conference, 208/1-208/18, Pittsburgh, PA.

Fortner Angela, Ray Paresh, Jagdish P. Singh and Rajamohan R. Kalluru. August 2005. *Metal-assisted photo-induced DNA damage: role of singlet oxygen and MLCT excitation*. 230th ACS National Meeting, Washington, DC.

F.X. Han, Y. Su, D.L. Monts and C. Waggoner. September 2005. *Bioavailability of mercury*

in Oak Ridge site. DOE Mercury Workshop, Oak Ridge, TN.

F.X. Han, Y. Su, D.L. Monts and C. Waggoner. February 2006. *Bioavailability and speciation of mercury in a soil from Oak Ridge, Tennessee, USA.* Annual Meeting and Conference of Southern Association of Agricultural Scientists, Orlando, FL.

F.X. Han, Y. Su, D.L. Monts, C. Waggoner and J.M. Plodinec. November 2005. *Phytoremediation of mercury contaminated soils.* Annual Meeting and Conference of Soil Science Society of America, Salt Lake City, UT.

Ping-Rey Jang, Rangaswami Arunkumar, Zhiling Long, Melissa A. Mott, Walter P. Okhuysen, Yi Su, David L. Monts, Paula G. Kirk and John Ettien. February 2006. *Quantitative imaging evaluation of corrosion in the Oak Ridge Research Reactor pool.* Waste Management 2006 Symposium, Paper No. 6098. (Contributed presentation presented by David L. Monts), Tucson, AZ.

Chan K. Kim, Rajamohan R. Kalluru, Scott Willard, Alicia N. Musselwhite, Fang Y. Yueh and Jagdish P. Singh. October 2005. *Optimized optical fiber laser-induced fluorescence (LIF) sensor for human breast cancer cell line diagnosis.* SPIE-Optics East 2005, Boston, MA.

Chan K. Kim, Rajamohan R. Kalluru, Jagdish P. Singh and Scott Willard. March 2006. *Effect of the excitation wavelength on laser induced fluorescence of the human breast cancer cell lines.* PITTCON 2006, Orlando, FL.

Chan K. Kim, Rajamohan R. Kalluru, Jagdish P. Singh and Scott Willard. March 2006. *Development of laser induced fluorescence sensor for the detection of human breast cancer cell lines conjugated with gold nanoparticles.* OSA Biomedical Optics Topical Meeting, Fort Lauderdale, FL. <<http://www.sunny.org/>>

J.S. Lindner, R.K. Toghiani and L.T. Smith. October 2005. *Fractional crystallization of Hanford supernatant streams.* Poster presentation at 14th Symposium on Separation Science and Technology for Energy Applications, Gatlinburg, TN.

J.S. Lindner, R.K. Toghiani, V. Phillips, M. Jung, L.T. Smith and M.J. Plodinec. August 2005. *Process chemistry support for Hanford.* Presented to CH2M Hill, Hanford Site, Richland, WA.

J.S. Lindner. August 2005. *Diagnostic Instrumentation and Analysis Laboratory, A Tradition of Excellence in the Bagley College of Engineering at Mississippi State University since 1976.* Presented to U.S. Department of Energy, Office of River Protection, and CH2M Hill Hanford Personnel.

David L. Monts, Ping-Rey Jang, Zhiling Long, Walter P. Okhuysen, Yi Su and M. John Plodinec. September 2005. *Development of quantitative imaging probe systems for in situ volumetric determination of Hanford tank wastes.* Proceedings of Tenth International Con-

ference on Environmental Remediation and Radioactive Waste Management (ICEM05), Paper No. 1065 presented by D.L. Monts. Glasgow, Scotland.

D.L. Monts, F.X. Han, Y. Su, C.A. Waggoner and M.J. Plodinec. September 2005. *Bioavailability and speciation of mercury in soils from Oak Ridge, Tennessee, USA*. Proceedings of Tenth International Conference on Environmental Remediation and Radioactive Waste Management, Paper No. 1173 presented by D.L. Monts. Scottish Exhibition and Conference Centre, Glasgow, Scotland.

D.L. Monts, Y. Su, F.X. Han, B.B.M. Sridhar, C.A. Waggoner and M.J. Plodinec. September 2005. *Investigation of the efficiency of mercury uptake by selected plant species*. Proceedings of Tenth International Conference on Environmental Remediation and Radioactive Waste Management, Paper No. 1174 presented by Y. Su. Scottish Exhibition and Conference Centre, Glasgow, Scotland.

David L. Monts. January 2006. *Long wave infrared spectral imaging: applications to national security*. Future Trends in Spectroscopy: Application to National Security, Indo-US Forum on Science and Technology, Varanasi, India, (invited presentation). Also participated in panel discussion concluding workshop.

O.P. Norton, A. Giordana, R. Palmer, M. McCarthy and W.G. Ramsey. September 2005. *Incorporation of coal gasification slag into foamed glass material*. Pittsburgh Coal Conference, Pittsburgh, PA.

O.P. Norton. March 2005. *Incorporation of coal gasification slag into foamed glass material*. Presentation at NETL kick-off meeting, Morgantown, WV.

S.Y. Oh, T. Miller, F.Y. Yueh and J.P. Singh. February 2006. *Laser induced breakdown spectroscopy: application to slurry analysis*. Laser Applications to Chemical, Security and Environmental Analysis (LACSEA), Optical Society of America (OSA) Topical Meeting, Incline Village, NV.

Seong Yong Oh, Fang-Yu Yueh and Jagdish P. Singh. March 2006. *Laser induced breakdown spectroscopy: application to slurry analysis*. PITTCON 2006, Orlando, FL.

S.Y. Oh, T. Miller, J. Branch, F.Y. Yueh and Jagdish P. Singh. April 2005. *Slurry product analysis with laser induced breakdown spectroscopy*. 107th Annual Meeting and Exposition of the American Ceramic Society, Baltimore, MD.

R.A. Palmer. September 2005. *Glass reactivity: the contribution of Larry Hench to radioactive waste vitrification*. Presented at the Professor Larry L. Hench Retirement Symposium, Imperial College, London.

L.T. Smith, J.S. Lindner, R.K. Toghiani, A. Antonyraj and V. Phillips. October 2005. *Modeling and experiments for the SRS low-Curie salt process*. Poster presentation at 14th Symposium on Separation Science and Technology for Energy Applications, Gatlinburg, TN.

L.T. Smith, R.K. Toghiani and J.S. Lindner. May 2006. *Tank retrieval modeling*. Presentation at RPP/WTP-SRS-Idaho Cleanup Project-CH2MHILL Technical Exchange, Richland, WA.

Vidhu S. Tiwari, Rajamohan R. Kalluru, Fang-Yu Yueh, Jagdish P. Singh and Robert L. Cook. June 2006. Study of temperature measurement of high pressure super heated hydrogen by Raman spectroscopy. AIAA-2006- 57114 37th AIAA Plasma dynamics and Lasers Conference, San Francisco, CA.

R.K. Toghiani, L.T. Smith, V. Phillips, M.H. Jung, D. Selvaraj and J.S. Lindner. October 2005. *Improved process chemistry for legacy nuclear waste remediation: development of DBLSLTDB*. Paper presented at 14th Symposium on Separation Science and Technology for Energy Applications, Gatlinburg, TN.

Y. Su, P. Jang, Z. Long, L.L. Gresham and D.L. Monts. October 2005. *Portable real-time LWIR spectral imaging system for detecting and visualizing toxic chemical plumes*. 2005 Conference on Sensors and Photonics for Applications in Industry, Life Sciences, and Communication (Optics East 2005) Paper 5995-22. Boston, MA. Presented by Yi Su.

Yi Su, Ping-Rey Jang, Zhiling Long, L. Lee Gresham, Walter P. Okhuysen and David L. Monts. January 2006. *Application of the use of long-wave infrared spectral imaging to national security*. First Indo-US Symposium on Spectroscopy: Application to National Security, Varanasi, India.

S. Tao, X. Hu and Q. Yang. September. September 2005. *A fiber optic sensor for in situ real-time monitoring H₂O₂ in a PEM fuel cell during fuel cell operation*. Proceedings of 22nd International Pittsburgh Coal Conference, 178/1-178/14, Pittsburgh, PA.

Vidhu S. Tiwari, Sunil K. Khijwania, Rajamohan R. Kalluru, Fang-Yu Yueh and Jagdish P. Singh. October 2005. *Designing of a prototype fiber optic Raman sensor*. SPIE-Optics East 2005, Boston, MA.

R.K. Toghiani, L.T. Smith, J.S. Lindner, G.I. Tachiev and G. Yaari. February 2006. *Modeling of pilot-scale salt cake dissolution*. Waste Management 06, Tucson, AZ.

Hongbo Zheng, Fang Yu Yueh, Shane Burgess and Jagdish P. Singh. February 2006. *Laser induced breakdown spectroscopy - application to tissue analysis*. Laser Applications to Chemical, Security and Environmental Analysis (LACSEA2006), Optical Society of America (OSA) Topical Meeting, Incline Village, NV.

Patents and Coyprights

Shiquan Tao, Christopher B. Winstead, J.P. Singh and R. Jindal. *Optical fiber sensor having a sol-gel fiber core and a method of making*. U.S. Patent No. 7,058,243.

Shiquan Tao, Christopher B. Winstead and J. P. Singh. *Moisture sensor based on evanescent*

wave light scattering by porous sol-gel silica coating. U.S. Patent No. 7,037,554.

Theses and Dissertations

Mi-Hee Jung. December 2005. *Solubility studies on the NaAlO₂-NaNO₃-H₂O System*. Masters Thesis. Swalm School of Chemical Engineering, Bagley College of Engineering, Mississippi State University. (R.K. Toghiani and J.S. Lindner, research advisors).

Armstrong Ebot Mbi. May 2006. *Novel fiber optic temperature sensors: fiber grating loop ringdown*. Masters Thesis. Department of Physics and Astrology, College of Arts and Sciences, Mississippi State University. (Chuji Wang, research advisor).

Michel E. Okhuysen. May 2006. Non-thesis Master of Science. Department of Physics and Astrology, College of Arts and Sciences, Mississippi State University. (David Monts, research advisor).