The Postdoc

Spring-Summer 2010

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Dr. Manomita Patra, NRC Associate-EPA

NATIONAL RESEARCH COUNCIL OF THE NATIONAL ACADEMIES

Environmental Implications of Nanoparticles

Dr. Manomita Patra joined the EPA's, Human Exposure and Atmospheric Sciences Division in Las Vegas, Nevada, as a **NRC Research Associate** in June 2007. Her research project parallels her previous interests in the genotoxicity of mercury in plants. She is working with Dr. Kim Rogers and Tammy Jones-Lepp (NERL-Human Exposure & Atmospheric Sciences and Environmental Sciences Divisions, Las Vegas, NV) in the emerging area of environmental implications of nanomaterials.

Nanomaterials possess unique properties which are often dissimilar from macro-scale particles with the same elemental composition. Because they show the potential to improve many of the physical characteristics of a wide range of products, their prevalence in the environment is likely to increase, along with the potential risks for human and ecosystem exposure. The potential for exposure will be affected by physical and chemical properties that influence nanomaterial movement through air, soil, and aquatic ecosystems. These characteristics also influence the biological/environmental interface.

Because nanomaterials have not been well characterized with respect to potential environmental contamination, part of her work has focused on this area. Nanomaterials being studied include nanosilver (an antimicrobial used in a number of household products ranging from socks to food storage containers), titanium dioxide (used in sunscreens and cosmetics) and fullerenes (such as Bucky balls, used as additives for polymers and potential carriers for pharmaceuticals). These materials are being investigated with respect to size, shape, surface charge and aggregation behavior in aqueous environmental media.

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Ray Gamble, Ph.D., Director, Research Associateship Programs Suzanne White, Manager, Newsletter

The NRC Research Associateship Programs Newsletter is published quarterly to highlight research and activities of NRC Associates and Advisers who participate in the programs with our many agencies and laboratories. All of our Newsletters are posted on our Web site Newsletter Web page in full-color PDFs. In addition, the full-color, highgloss version is printed by the National Academy Press (NAP); and bulk orders of 10 or more are available from our office for distribution at agencies/laboratories, scientific meetings, NRC meetings, staff visits, and site visits. We accept articles throughout the year-- press releases, profiles, 1 - 2 page articles already written and/or submitted to other publications, images, photos, notices, awards, honors, etc. Send all inquiries and submissions to Suzanne White (swhite@nas.edu)

NRC Associateship Programs Staff members will be available at a 2010 Exhibit Booth

American Institute for Aeronautics and Astronautics	Orlando	FL	01/04/10-01/07/10
Joint Mathematics Meeting	San Francisco	CA	01/13/10-01/16/10
American Meteorological Society	Atlanta	GA	01/17/10-01/21/10
Society of Photo-optical and Instrumentation Engineers	San Francisco	CA	01/26/10-01/28-10
National Society of Black Physicists-National Society of Hispanic Physicists	Washington	DC	02/11/10-02/15/10
Biophysical Society	San Francisco	CA	02/20/10-02/24/10
Johns Hopkins Medical Institutions Biomedical Career Fair	Baltimore	MD	03/01/10-01/01/10
Johns Hopkins University Science & Technology Career Fair	Baltimore	MD	03/02/10-03/02/10
Society of Toxicology	Salt Lake City	UT	03/07/10-03/10/10
American Physical Society	Portland	OR	03/15/10-03/19/10
American Chemical Society Spring Meeting	San Francisco	CA	03/22/10-03/24/10
National Organization of Black Chemists and Chemical Engineers	Atlanta	GA	03/29/10-04/03/10
National Society of Black Engineers	Toronto	ONT	03/31/10-04/04/10
American Association of Petroleum Geologists	New Orleans	LA	04/11/10-04/14/10
Experimental Biology	Anaheim	CA	04/24/10-04/28-10
American Society for Microbiology	San Diego	CA	05/23/10-05/27/10
Ecological Society of America	Pittsburgh	PA	08/01/10-08/06/10
American Chemical Society Fall Meeting	Boston	MA	08/23/10-08/25/10
American Fisheries Society	Pittsburgh	PA	09/12/10-09/16/10
Hispanic Association of Colleges and Universities	San Diego	CA	09/18/10-09/20/10
Society for the Advancement of Chicanos and Native Americans in Science &			
Mexican American Science and Engineering Society	Anaheim	CA	09/30/10-10/03/10
Science and Engineering Alliance Student Technical Conference	Washington	DC	10/01/10-10/01/10
Florida Education Fund McKnight Fellows Meeting	Tampa	FL	10/01/10-10/03/10
Human Factors and Ergonomics Society	San Francisco	CA	10/19/10-10/23/10
Geological Society of America	Denver	CO	10/31/10-11/03/10
American Society for Tropical Medicine and Hygiene	Atlanta	GA	11/03/10-11/07/10
American Public Health Association	Denver	CO	11/06/10-11/10/10
Society for Environmental Toxicology and Chemistry	Portland	OR	11/07/10-11/11/10
Annual Biomedical Research Conference for Minority Students	Charlotte	NC	11/10/10-11/13/10
American Indian Science and Engineering Society	Albuquerque	NM	11/11/10-11/13/10
Society for Neuroscience	San Diego	CA	11/13/10-11/17/10
Materials Research Society	Boston	MA	11/29/10-12/03/10
American Society for Cell Biology	Philadelphia	РА	12/11/10-12/15/10
American Geophysical Union	San Francisco	CA	12/13/10-12/17/10

The Original Third Tuesday Networking Extravaganza Recent events average 300+ people. It's the Event everyone is talking about. You don't want to miss the "Third Tuesday" of each month



Clydes Tower Oaks Lodge 2 Preserve Parkway Rockville, MD 20852

NO CHARGE TO ATTEND

We'll be in the back bar. Just follow the signs. It's a Cash Bar and Clyde's NEW GM, Ron Robbins, will select some delectable hors d'oeuvres for our group. Great Opportunity for lots of "B2B" Networking and tons of fun. *Free Valet Parking is available. Stay for dinner and enjoy Uncle Clyde's Lobster Special* <u>http://thref.nesters.com/forme.com/</u> **Contact** <u>Con Dobrandor Ange Secol & Kon Kahlum</u> **for event and ticket information**

NRL announces 2009 winners of NRC/ASEE Postdoctoral Research Publication Awards Nasir Mansoor - NRC Albert Epshteyn - ASEE

Albert Epshteyn – ASEF Aous Abdo – NRC J. F. Helmbolt – NRC S. I. Maximenko – NRC Lena Mazeina - NRC C. Chervin – NRC

continued from page 1

The chemical and structural analyses of these materials rely on techniques such as UV-Visible spectroscopy, Transmission Electron Microscopy, Nanoparticle Tracking Analysis and Graphite Furnace Atomic Absorption Spectroscopy.

Another aspect of this project involves the study of ecosystem exposure. Organisms often used as ecosystem indicators include the planktonic crustaceans which are generally the food and energy link between the primary producers (algae) and secondary consumers (fish and fish larvae). Due to their rapid filtration rate these filter feeding organisms impact water turbidity and algal composition and consequently play an important role in fresh water ecosystems. Dr. Patra has also been investigating exposure of the micocrustacean indicator organism *Thamnocephalus platyurus* to the carbon nanomaterial C_{60} .

In the absence of an added food source, *T. platyurus* were found to accumulate the fullerene C_{60} . The accumulated nanoparticles have been chemically identified as well as visualized in the digestive tract of these organisms using optical microscopy and thin section TEM. Because of the tendency for these organisms to filter and excrete carbon-based nanomaterials in an agglomerated state, they have the potential to significantly change the size, distribution, and fate of these nanoparticles in the environment.

Dr. Patra has also been working with another ecosystem indicator assay that involves cellular growth in the root tip of plants. This technically simple, relatively fast, and inexpensive assay for genotoxicity (Allium test) is conducted using microscopic analysis of onion root tips. This test detects various chromosomal aberrations seen as chromosome breaks, polyploidy, early or late separation, lagging of chromosomes, sticky bridges, uneven separation, clumping, and multiple pole formation. A trend toward decreases in mitotic index (index of measuring cell division), and increase in frequency of chromosomal aberrations were observed with increased exposure of the developing root tip cells to several types of nanoparticles. These findings are significant since cell damage in indicator plant species may be transmitted to subsequent generations, possibly affecting the whole organism and the exposed local biota as well.

Dr. Patra has presented her research at the American Chemical Society and Society of Environmental Toxicology and Chemistry national meetings and she was most recently invited to be a guest speaker at a conference in India.



http://www7.national-academies.org/rap

The development of inexpensive renewable energy sources is one of our major challenges. In addition, current power sources that Warfighter carry, such as disposable batteries, are heavy, costly, and limited in energy-density and renewability. There is an urgent need to reduce the Warfighter's load and increase the sustainability with renewable power sources. Silicon and other inorganic single crystal based solar cells offer high power conversion efficiencies from sun light to electricity. However, these photovoltaic devices are bulky, heavy, expensive and nonflexible as compact renewable power sources for military application, and the cost per peak power makes it unaffordable for a large fraction of the world population. Alternative approaches to less expensive photovoltaic devices are being extensively investigated. While the dye sensitized solar cell, utilizing TiO2 nano-particles and organic dye molecules, is a promising approach, it uses liquid electrolytes, making it unattractive because the electrolyte can leak out and is often corrosive. Replacing the liquid electrolyte with a solid state hole-transporting conjugated polymer would offer a major technical breakthrough.

The delocalized electrons in the conjugated polymers can facilitate efficient charge transport. Organic polymer-based solar cells have also been extensively investigated as an alternative cost-effective approach to conformal renewable power. These two types of solar cells are wellsuited for mass-production on flexible plastic substrates by conventional roll-to-roll printing methods, which will lead to inexpensive and light-weight photovoltaic devices. But, the power conversion efficiency of these solar cells is currently significantly lower than that of the inorganic solar cells. Improving the conversion efficiency of these solar cells is needed.

Dr. Lian Li received his Ph.D. from University of Massachusetts Lowell in 1993. For the past ten years, he has been involved in research and development of organic materials based solar cells at Molecular Technologies Inc., Konarka Technologies Inc., and University of Massachusetts Lowell. Since August 2007, he has been working as a senior NRC research associate under his adviser, Dr. Lynne Samuelson at the US Army Natick Soldier Research, Development and Engineering Center (NSRDEC) in Natick, Massachusetts. In collaboration with University of Massachusetts Lowell, TiO₂/ conjugated polymer nanocomposites have



Dr. Lian Li, NRC Associate at NSRDEC

been developed and materials with novel nanostructures have been employed in the dye-sensitized and organic polymer based solar cells.

Through the NRC Research Associateship Program, Dr. Li has demonstrated that the nanostructured materials can significantly enhance the power conversion efficiency of the organic materials based solar cells. To date, incorporating desirable conjugated polymers, such as polydiacetylenes, into the small nanopores of TiO2 to fabricate efficient nanocomposites of TiO2/conjugated polymers was impossible because of the large size of the polymer chains.

Howeverm Dr. Lian Li was able to develop an approach by first incorporating the diacetylene monomers from a dilute solution into the nanopores to create the TiO₂/monomer nanocomposites. The polymerization was then carried out in-situ in the nanopores using the photocatalytic properties of TiO₂ nanoparticles with visible light, leading to the formation of the TiO₂/polydiacetylene nanocomposites. Solar cells were successfully fabricated with the polydiacetylenes in the TiO₂ nanopores as hole transporters.



To achieve high photovoltaic performance, conventional photolithography is often employed to fabricate pyramid structures on the silicon solar cells to improve light-trapping and provide antireflection coatings for optimal light absorption. However, the lithographic method is expensive and timeconsuming.

Applications

During his NRC tenure, Dr. Li developed a simple and inexpensive pathway of creating well-ordered relief metal-oxide structures using surface relief patterns photoinscribed on azopolymer films as templates. The periodic one- and two-dimensional surface relief TiO₂ nanostructures were utilized to fabricate thin film dyesensitized solar cells. These lighttrapping structures enhanced the photovoltaic performance of the solar cells significantly as compared to those without the structures. This enhancement in power conversion efficiency is attributed to higher light-harvesting from light-trapping structures through increased optical path length in the solar cells. Nano-spikes produced by femtosecond laser pulses on silicon wafers have shown to be very efficient in lighttrapping. The nano-spike structures trap most of the visible light and look black. Large area nano-spike structures have been fabricated on silicon wafers and successfully incorporated into the organic polymer solar cells using thermal contact printing technique. This method can be easily scaled up with the roll-toroll production. It has been demonstrated that the solar cells with the light-trapping structures exhibited 20% enhancement in both photocurrent and conversion efficiency as compared with those without the structures due to the increased optical path-length in the active layer. Further enhancement of the photovoltaic performance is expected.



Spike structure on silicon wafer

Dr. John Kulp receives Young Investigator Award at the 21st American Peptide Society Symposium

Dr. John Kulp, current research scientist in NRL's Chemistry Division, and former NRC Associate, received the Young Investigator Award for his poster entitled, "Engineering Heterochiral Peptides" at the 21st American Peptide Society Symposium. The meeting was held in Bloomington, Indiana, on June 11, 2009. The poster, co-authored by Drs. Kulp and Thomas Clark, who work together in the Chemistry Division's Molecular Interfaces and Tribology Section, described the design, synthesis, and characterization of a set of peptide nanotubes having a range of possible applications, including stochastic sensing, which offers the promise of ultrasensitive, real-time detection.

On display at the conference were 345 posters, of which 121 posters were presented by postdoctoral fellows and advanced graduate students competing as young investigators. The competition consisted of three rounds of judging with each judge independently scoring the posters and presentations based on the following criteria: presentation, knowledge of the area, originality/novelty, and presenter's contribution to the work. Each round of judging resulted in a narrowing of the competition, leaving only 51 semifinalists and 17 finalists. Ultimately, Dr. Kulp was awarded the Young Investigator Award, which includes a manuscript submission to the journal Biopolymers. The combination of synthetic expertise and nuclear magnetic resonance (NMR) structure determination distinguished the NRL poster from the competition. This honor recognizes that the research being carried out by the NRL team is clearly cutting edge.

Chirality describes an object that is nonsuperposable on its mirror image; human hands are a common example. The peptides being developed are heterochiral, meaning they contain molecular building blocks that alternate in their chirality. These molecules fold into unique double helices that are controlled to have an overall left- or right-handed chirality. To achieve this control, the NRL team developed synthetic routes for making heterochiral peptides with discrete structural conformations. Previously, heterochiral peptides were difficult to investigate because they adopt multiple structures in solution. By making the peptide molecules cyclic, the authors were able to trap them into a distinct structural state: a prerequisite for developing functional peptides. Very few heterochiral peptides exist in nature, and all of them adopt their active structures in hydrophobic membrane environments.

The NRL authors proved that heterochiral peptides are not limited to membrane envi-



Dr. John Kulp, current research scientist in NRL's Chemistry Division, and former NRC Associate, is winner of a <u>Young Investigator Award</u> at the 21st American Peptide Society Symposium. Illustration below is of the right-handed heterochiral peptide structure developed, synthesized, and characterized at NRL.



ronments and can fold into discrete structures in polar solvents such as water. Their work opens the field of heterochiral peptides to numerous potential applications such as sensors, smart materials, and catalysts, thus enhancing NRL's multidisciplinary technology platform.

Dr. John Kulp earned his BA in Chemistry from Drew University in Madison, NJ. After completing his degree, he worked for the Sarnoff Corporation in Princeton, NJ, where he was granted his first patent application for synthetic peptide chemistry. In his pursuit of an advanced degree, he enrolled in the chemistry department at New York University in Manhattan, NY. Dr. Kulp received his PhD degree within four years, while completing eight publications. In December 2006, he joined **NRL's Chemistry Division as a NRC Associate**, and has since contributed two published papers, three papers in press, one patent application, one provisional patent application, and 10 presentations.

He is an active member of the NRL community as the organizer of the **2009 NRL Postdoctoral Colloquium Series**, and as a soccer player with the NRL soccer club.

6

Western Climate and Water



Galina Guentchev, Imtiaz Rangwala, and Kelly Mahoney on their way to Colorado's Fraser Experimental Forest. Photo by Robin Webb, NOAA.

It's hard enough to figure out, in a tooshort, two-year fellowship, how precipitation in the Colorado River Basin has varied historically, and how that variability may change with future warming. But ESRL postdoctoral researcher Galina Guentchev wants to push her research work even further.

"I want to do a better job relating my results to the needs of the people who are sponsoring my research, the Southern Nevada Water Authority (SNWA) and the U.S. Bureau of Reclamation (USBR), "Guentchev said. "I would like to be able to tell them what this variability means in terms of streamflow, and put it into a hydrological model."

Guentchev is one of four ESRL postdocs working on western water and climate issues this year, with support from NOAA's Climate Program Office, USBR, SNWA, and the National Research Council.

Joe Barsugli (Physical Sciences Division) organized a mid-November "mini-workshop" for the four postdocs, and he invited water management professionals with the Bureau of Reclamation and other agencies, to attend and help the young researchers refine their research plans.

After Guentchev presented her project, Imtiaz Rangwala discussed his proposal to dissect elevation-dependent warming in the Upper Basin of the Colorado River. "I'd like to improve our understanding of what's happening—in terms of past and future climate change—at elevations above 9,000 feet," Rangawala said. Kelly Mahoney described her goal to better understand how climate change will affect extreme precipitation events and therefore dam operations in the West. And Stephanie McAfee discussed how she plans to use tree-ring data and physiological plant models to investigate what appears to be accelerating tree mortality across the West. "We will be asking if today's events really are unique or unprecedented, or if they are widescale and jarring, but also standard," McAfee said.

Kristen Averyt, deputy director of NOAA/University of Colorado Western Water Assessment, praised the young scientists for tackling societal challenges in their research. "It's all about making science useful and getting it into the hands of people who are making decisions."

"This is a great lesson for NOAA, as it struggles to define the role of research in a national climate service," added ESRL's Robin Webb (Physical Sciences Division).



NRC Adviser, Patricia Quinn, elected AGU Fellow

NOAA's Pacific Marine Environmental Laboratory atmospheric chemistry scientist, Dr. Patricia Quinn, was recently notified by American Geophysical President, Timothy Grove, that she was elected fellow of the AGU. Dr. Quinn receives this well deserved recognition — only given to one in 1000 AGU members.

Link to more information on PMEL's atmospheric chemistry program <u>https://access.pmel.noaa.gov/,DanaInfo=.asbidDusltIxzmnNv4A+</u>

> Contact information Name: Patricia Quinn Tel: (206) 526-6892 patricia.k.quinn@noaa.gov

Pacific Marine Environmental Laboratory (PMEL) National Oceanic and Atmospheric Administration U.S.Department of Commerce http://www.pmel.noaa.gov





Sleep Research Society

2010 winner of the "Sleep Research Society Young Investigator Award"

"Congratulations to Dr. Tracy Rupp, NRC Associate, who was recently notified that she is a 2010 winner of the "Sleep Research Society Young Investigator Award!", writes Dr. Sara Roth, AWRAIR NRC Program Representative (LPR)

"Winners are selected by the Sleep Research Society based on scientific excellence as reflected in a recent publication. Tracy's winning publication was: Rupp TL, Wesensten NJ, Bliese PD, Balkin TJ. Banking sleep: realization of benefits during subsequent sleep restriction and recovery. Sleep. 2009 Mar 1;32 (3):311-21."

Within the sleep research community, this is the highest honor possible for a young investigator.

A formal presentation of this award will be made at the 2010 meeting of the Association of Professional Sleep Societies in San Antonio (June 5-9, 2010).

ICIWaRM Team Leads Workshop for Peru National Water Authority



Left to right: Pedro Guerrero, Technical Advisor to the director of the Modernization of Management of Water Resources Project, Hal Cardwell, USACE IWR NRC Adviser, Guillermo Mendoza, NRC Associate, Eddie Rosaza, director of PMGRH (Project for Modernization of Water Resources Management), Aleix Serrat-Capdevila, NRC Research Associate, Abelardo de la Torre, (then Director of the National Water Authority of Peru)

Two NRC Research Associates from the U.S. Army Corps of Engineers' (USACE) International Center for Integrated Water Resources Management (ICIWaRM) led an Integrated Water Resources Management (IWRM) workshop for Peru's National Water Authority (ANA) on August 17-21, 2009 in Lima, Peru. The workshop focused on application in a Peruvian setting of Shared Vision Planning - an integrated participatory water resources planning tool. The workshop was in support of a World Bank and Inter-American Development Bank (IDB) loan initiative to modernize water management in Peru.

The one-week workshop was followed by a presentation to the Vice Minister of Agriculture and a one-week session with the World Bank, IDB, and ANA staff. The follow-up session served as a forum to revise the terms of reference for implementation of the World Bank loan according to integrated and participatory water resources management principles.

Guillermo Mendoza, a NRC Research Associate at USACE's Institute for Water Resource (IWR), is leading the Peru work with technical support from fellow IWR Research Associate Aleix Serrat-Capdevila and from Hal Cardwell & Bill Werick of IWR's Shared Vision Planning program.

Shared Vision Planning (SVP) is a collaborative approach to formulating water management solutions that combines the three following disparate practices:

(1) traditional water resources planning,
(2) structured public participation and
(3) Collaborative computer modeling.



Dr. Tracy Rupp, NRC Associate at WRAIR

What makes Shared Vision Planning unique is the integration of traditional planning processes with structured public participation and collaborative computer modeling. Its goal is to improve the economic, environmental and social outcomes of water. Visit the Shared Vision Planning website for more information: www.SharedVisionPlanning.us



http://www7.national-academies.org/rap

Dr. Stacy Langsdale, **IWR National Research Council** Research Associate. to receive the 2010 ASCE Journal of Water Resources Planning and Management **Engineering Best Policy-Oriented** Paper Award for the paper Exploring the Implications of Climate Change on Water Resources through Participatory Modeling: Case Study of the Okanagan Basin, British Columbia."

The paper addresses the implications of incorporating climate change into water resources planning initiatives, which is difficult both because relevant information is not readily accessible and the methods for adjusting policy and operations are not obvious.

Co-authors Allyson Beall, PhD, Jeff Carmichael, PhD, Stewart Cohen, PhD, Craig Forster, PhD, and Tina Neale, PhD, will also receive the 2010 ASCE award. It was published in the September/ October 2009 issue of the Journalf Water Resources Planing and Management. Stacy is IWR's National Research Council Research Associate for 2007-2010.

To address these issues, the team engaged stakeholders in a group model building process to explore plausible water resources futures for the Okanagan Basin, British Columbia, Canada, through a series of five one-day workshops held over a 12-month period. Workshops were intended to create NRC Research Associateship Programs Newsletter



Dr. Stacy Langsdale, NRC Associate at IWR

IWR NRC **Associate Stacy Langsdale** receives 2010 **EWRI** Award for best policyoriented paper

a shared learning experience, develop a customized exploration tool, and create participant trust in the model. Survey results indicated the exercise helped participants to expand their thinking to the basin scale, appreciate the complexity of water management, and develop a model suitable for futures exploration and outreach.





US Army Corps of Engineers Institute for Water Resources



Center: Arvind Chaturvedi, NRC Research Adviser at FAA CAMI, accepts the Aviation Safety Innovation Technical Award. Flanking him are Deputy Associate Administrator for Aviation Safety John Hickey, Acting Deputy Administrator Lynne Osmus, Associate Administrator for Aviation Safety Peggy Gilligan, and Dr. Fred Tilton, Federal Air Surgeon.

A drop of human blood contains incredible amounts of information. A sample, for instance, taken from a person who inhaled toxic gases and smoke from a fire can reveal how incapacitated the victim was before death.

Such uses for blood have been of keen interest to researchers at the Civil Aerospace Medical Institute in Oklahoma City for years. That facility specializes in aviation forensic toxicology, the only institute of its particular kind and caliber in the world.

The excellence of its staff earned special attention recently with the recognition of **Arvind Chaturvedi**, **National Research Council Adviser**, who earlier this year won the Aviation Safety Innovation Technical Award for helping to develop a blood analysis standard for the International Organization for Standardization.

Chaturvedi, team coordinator of biochemistry research and an agency employee of nearly 20 years, was first approached by the ISO in 2004. Partly due to a toxicology colloquium he organized almost 10 years prior about combustion gases, he was asked to lead an international team of scientists. The working group was to assemble a document with the potential for widespread safety ramifications, including the creation of fire safety regulations and better design of fire safety instruments.

For FAA scientist, better fire safety is in the blood



Federal Aviation Administration Fire Safety

"The research that's been done at CAMI played a big role in making that standard," he said.

The ISO's national membership uniformly hailed the 57page document that resulted from the effort as outstanding. Included in the standard was an equation derived at CAMI that can be used to determine the degree of impairment to people in a smoke-filled environment. The equation is so accurate that it was adopted by the French government even before the standard was finalized.

"I'm 100 percent sure [the standard] has merit and I feel satisfied," Chaturvedi said.

The field of forensic toxicology in aviation is a complex one. Chaturvedi and his CAMI colleagues receive blood samples from fire-related aviation accident victims from all over the country. They examine the samples for traces of poisonous gases and other toxins. Their concentrations, for example, can give clues about the situation under which an incident occurred.

It is the lab experts' jobs to not only help deduce the circumstances leading up to a person's death (or incapacitation), but also to ensure the entire process is of the highest quality. Such oversight requires a wide range of experience, which Chaturvedi in particular possesses. He has training in chemistry, pharmacology, and toxicology.

Although Chaturvedi is humble when speaking of his contributions to fire safety, his peers clearly recognize his remarkable expertise and hard work — hence, the award for innovation. One would never suspect that during key stages of the ISO document's production, Chaturvedi worked from a hospital bed.

Now healthy, the scientist underwent chemotherapy treatments for cancer at the same time he was engaged in intense research for the international standard. He credits his wife and her support for his recovery, as well as the support of his colleagues and the agency.

"Maybe it's because of all their well-wishing that I am here," Chaturvedi said.

Science Technology Engineering Math

S.T.E.M. Postdoc Conference and Career Fair

Bethesda North Marriott Conference Center

July 22, 2010 \$a.m.-4 p.m.

Last year 475 scientists from area federal agencies and universities attended.

www.RockvilleREDI.org 301-315-8096

Exhibitors' fees same as 2009. But there will be a \$5 charge for attendees!

Dr. Dennis Canfield recipient of 2010 Robert F. Borkenstein Award

The National Safety Council awarded Dennis V. Canfield, Ph.D., a Federal Aviation Administration forensic scientist, the 19th recipient of its Robert F. Borkenstein Award. The Award, named after Professor Robert F. Borkenstein, the inventor of the Breathalyzer[®], recognizes persons who have made outstanding contributions through a lifetime of service in the field of alcohol/drugs in relation to traffic and transportation safety.

Dr. Dennis Canfield, a National Research Council Associateship Programs Adviser at FAA, is an internationally-recognized forensic scientist, researcher and administrator for the Civil Aerospace Medical Institute of the Federal Aviation Administration in Oklahoma City. His laboratory is one of only three in the Federal Government that conducts research and performs case work in forensic toxicology.

On behalf of the Federal Aviation Administration and the National Transportation Safety Board, Dr. Canfield's laboratory investigates the medical and scientific aspects of all fatal aviation crashes. In July 2007, testimony before the U. S. House of Representatives Committee on Transportation and Infrastructure, Dr. Canfield's unit was described as *"likely the finest toxicology laboratory in the world for analysis of specimens from accident investigations."*

Dr. Canfield has written or co-written 46 peer-reviewed publications. He is the author of hundreds of scientific abstracts and has been a presenter at more than 75 professional meetings. He has provided effective expert witness testimony in the courts of several states and before hearings of the FAA and NTSB.

A Fellow of the Criminalistics Section of the American Academy of Forensic Sciences, Dr. Canfield also is a member of the Society of Forensic Toxicologists. In addition, he has served on the Forensic Science Advisory Board of the University of Central Oklahoma and is currently the Vice Chair of the NSC Committee of Alcohol and Other Drugs.

The Robert F. Borkenstein Award was presented to Dr. Canfield in Seattle on Feb. 22, 2010 by Kurt M. Dubowski, Ph.D., LL.D., DABCC, DABFT.



Dr. Dennis Canfield, NRC Adviser at FAA





Dr. Robert F. Borkenstein Inventor of the Breathalyzer

About the Award

The Professor Robert F. Borkenstein Award recognizes individuals who have made outstanding contributions through a lifetime of service consistent with the ideals and achievements of Dr. Robert F. Borkenstein. These contributions will be in the area of alcohol/drugs in relation to traffic and transportation safety.

Sponsor

The Robert F. Borkenstein Award is conferred by the National Safety Council : Highway Traffic Safety Section. Many members of IACT are recipients of this Award.

Qualifications

Persons nominated must, through a minimum tenure of twenty-five years of active service in the field of alcohol/drugs and traffic safety, have contributed to that field to a degree that their achievements have been nationally recognized. A minimum of ten years of active and productive involvement as a volunteer with the National Safety Council must be shown. Career contributions will have been in one of the following areas: (1) alcohol education; (2) legal matters, including prosecution, defense, adjudication, or research of alcohol-related cases: (3) human factors -- the involvement in scientific research and studies of alcohol and the medical/physiological/psychological aspects of alcohol and traffic safety; (4) technology-toxicological procedures involving alcohol/drugs and development and evaluation of techniques; and (5) action programs -- law enforcement, legislation, public information, intervention efforts, and other social factors related to alcohol/drugs and traffic safety.

INTRODUCTION

The *in situ* characterization of small particles is a persistent objective in

Holographic Imaging of Particles

applied electromagnetic scattering. Countless examples of measurements and theoretical modeling of the scattering patterns of single and multiple particles can be found in the literature. A typical goal of such work is to infer information relating to the particles' physical form, such as size and shape, by analyzing the angular structure of the scattering patterns. This inference has proved to be very difficult in practice, except for the simplest of cases. Ideally, one would prefer to image particles directly, thus eliminating the complexity and ambiguity associated with interpretation of the scattering patterns.

However, for micrometer sized particles, *in situ* imaging using conventional geometrical optics is not feasible due to the variability of particle position, optical aberrations, diffraction, and the limited numerical aperture of the imaging system. Holography is an alternative that can provide particle images while being free from much of these limitations. This work will present an apparatus to measure single and multiple-particle holograms and demonstrate the computational reconstruction of particle images from the holograms.

HOLOGRAPHIC IMAGING

In the context of this work, holography is the measurement of the interference between the light illuminating a particle and the particle's far-field scattered wave. This interference pattern constitutes a system of fringes measured by the detector, the specific structure of which is controlled by the local relative phase between the illuminating and scattered waves across the detector face. Consequently, the hologram is as complicated as the associated scattering pattern. However, unlike the scattering pattern, a simple computational operation can be performed to render an image of the particle. In short, the hologram is regarded as a transmission diffraction grating and the Fresnel-Kirchhoff (FK) integral is used to calculate its near-field diffraction pattern under plane-wave illumination. This calculation can be done rapidly since the FK integral is evaluated using fast Fourier transforms. The reconstruction is done in a plane that is parallel to the hologram; if the plane corresponds to the plane containing the particle during the measurement, the resulting diffrac-





Figure 1. Holographic imaging apparatus (a) and corresponding diagram (b).

tion pattern produces an image of the particle. Otherwise, a blurred image results. The resolution of the image is ultimately limited by the pixel and array size of the CCD and the wavelength used. It is for this reason that computer-based holographic imagereconstruction is a relatively new technology; large CCD arrays with sufficiently small pixels have only recently become economical and widely available.

APPARATUS AND MEASURE-MENTS

Figure (1) shows a picture (a) and the corresponding diagram (b)



Matt Berg, NRC Associate, ARL

of the apparatus used to measure single-particle holograms. The design is based on the so-called in-line configuration, where the particle, optical components, and detector are all co-linearly arranged. The light source is a 70 ns pulsed Nd:YAG laser, frequency doubled to 532 nm. This light passes through a Glan-Thompson (GT) polarizer to ensure linear polarization of the light before being focused by lens L1 onto a 50 µm diameter high-power pinhole. An iris (I) is used to block all but the primary lobe of the pinhole diffraction pattern from reaching a second lens (L2). This short focal-length lens brings the lobe to a tight waist at a location near the trapping volume of a spherical-void electrodynamic levitator (SVEL). A particle confined in this volume is illuminated by the light diverging from the waist; hence, the waist effectively acts as a virtual point source producing a spherical wave. This wave continues to expand until it reaches the CCD detector along with the scattered light from the particle. The resulting interference pattern between these waves across the CCD constitutes the hologram.

By using a short focal-length lens to form a virtual source near the particle, the light illuminating the particle is more intense than it would be if only the pinhole was used for illumination. This is because the particle can be brought closer to the virtual source than it can be to the pinhole. The results is an effective amplification of the particle's scattered wave at the CCD face, which enhances the interference structure of the hologram leading to improved particle-image quality. Using a pulsed laser permits the investigation of particle systems in motion. This is especially useful for aerosol applications where particles may be delivered to the apparatus in a flowing stream.

The in-line configuration used to form the hologram is traditionally problematic since the reconstruction process produces both a real and virtual image. These twin images overlap in the reconstruction plane; if one is in focus, the other is blurred and diminishes the quality of the focused image. Using computational techniques, the influence of the out-of-focus twin image is suppressed in the reconstruction stage. The advantage of the in-line configuration, however, is that it typically requires the least number of optical components. This is important when imaging micrometer sized particles because ambient dust, which is of similar size and inevitably collects on these surfaces, will contribute to the hologram leading to noise and ambiguity upon reconstruction.

Figure (2) shows two examples of the particle holograms and their corresponding reconstructed particle-images. One can

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see in these plots that the technique is successful in imaging particles as small as 20 μ m and as large as 300 μ m. Modifications to the optical apparatus are planned that are intended to improve the resolution of the imaging process. The ultimate goal of these modifications is to image particle with nominal sizes from one to ten microns, which covers much of the size range of environmental aerosols of interest.



ACKNOWLEDGMENTS

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Figure 2. Particle holograms and their reconstructed images. Plot (a) shows the hologram produced by a single 20 μ m diameter glass microsphere trapped in the SVEL. The image of this particle reconstructed from the hologram in (a) is shown in (b). The hologram in (c) corresponds to a sample of Tunisian sand particles sprinkled onto a glass slide and placed at the location of the SVEL in Fig. (1). This is done because the sand is too large to be suspended in the SVEL. The reconstructed images of these particles is shown in (d), where one can clearly see the clustered, nonspherical nature of the particles.

2500

2000

-200

-200

-100

0.0

x [µm]

100

200

NRL ranks high among postdocs

0

0

500

1000

x [pix]

1500

In a survey recently conducted by *The Scientist* magazine, the Naval Research Laboratory (NRL) ranked 16th among 90 U.S. and international institutions as the best places to work for postdocs. NRL currently has two postdoctoral programs — ASEE and the **National Research Council (NRC) Associateship Program.**



The NRC Associateship programs are currently and traditionally the largest postdoctoral research programs at NRL and NIST.

During September through November 2009, email invitations were sent to readers of *The Scientist* and registered users on The Scientist web site who were identified as non-tenured life scientists working in academia or other non-commercial research institutions. Postdocs were asked to assess their working environment based on such criteria as quality of training and mentoring, value of postdoc experience, career development opportunities and funding. Listed as two of NRL's biggest strengths were compensation and equity. The 16th place ranking positions NRL above other renowned government organizations like the National Institutes of Health (NIH) and the National Institute of Standards and Technologies (NIST).

NRL is the Department of the Navy's corporate laboratory. NRL conducts a broad program of scientific research, technology, and advanced development. The Laboratory, with a total complement of approximately 2,500 personnel, is located in southwest Washington, DC, with other major sites at the Stennis Space Center, MS; and Monterey, CA. NRC Research Associateship Programs Newsletter

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Dr. Sara Rothman, Associate Science Director for Research Review at the Walter Reed Army Institute of Research (WRAIR), and the Laboratory Representative to and for the National Research Associateship Programs, has been named the recipient of the 2010 Roche Diagnostics Alice C. Evans Award. This award is given by the American Society for Microbiology (ASM) and will be presented at the ASM General Meeting, 23-27 May 2010 in San Diego. The Roche DiagDr. Rothman's interests are health science research administration and policy, including management of the Institute's research portfolio; research integrity and responsible conduct of research; human subjects protection; quality assurance; physician credentialing; extramural contracts; laboratory design; **the National Research Council Associateship program**; bacterial toxicology, anaerobic bacteriology; immunology; and cell biology.



WRAIR scientist receives 2010 Roche Diagnostics Alice C. Evans Award

nostics Alice C. Evans Award honors a member of ASM for major contributions toward the full participation and advancement of women in microbiology. This award was established by the ASM's Committee on the Status of Women in Microbiology, and is given in memory of Alice C. Evans, the first woman to be elected ASM President in 1928.

To be eligible for this award, the nominee can be any member of ASM who has made major contributions toward fostering the inclusion, development, and advancement of women in careers in microbiology. The nominee must demonstrate commitment to women in science through mentorship and advocacy and by setting an example through scientific and professional achievement.

Dr. Rothman joined the WRAIR in 1978 as Research Chemist in the Department of Biological Chemistry, Division of Biochemistry. Since then she has served as Research Chemist, Department of Molecular Pathology, Division of Pathology; Deputy Project Officer, Construction of the New Walter Reed Army Institute of Research; and Director, Office of Research Management. Dr. Rothman has a Ph.D. in microbiology/biochemistry from Boston University (BU), an MA in microbiology from BU, and a BS in biology from Simmons College.



Dr. Rothman exemplifies the advancement of women in science and the merits required to receive the Roche Diagnostics Alice C. Evans Award. As stated by Rothman's colleague, Barbara H. Iglewski, Ph.D.:

Dr. Sara Rothman, NRC LPR at WRAIR

"Dr. Rothman has been enormously successful as a scientist and administrator, but it is her many roles as a volunteer in various professional organizations which has allowed her to work tirelessly to mentor women in microbiology and to support women scientists at all levels. She was a founding member of the Washington Chapter of the Association of Women in Science and was long involved as a member and latter as Chair of the Committee of the Status of Woman Microbiologists. She organized and convened numerous roundtables at ASM general meetings as well as spending countless hours counseling and advising individual and groups of women on their careers. She has supported many senior microbiologists by nominating them for awards and leadership positions hence supporting their career advancement. I personally have benefited from her counseling and support of my own career and my election as President of ASM. She helped establish this very award as well as the Morrison Rogosa Award, for young women working in microbiology in Eastern Europe."

Justin establishes elder care foundation

"I, Augustus Edwin Justin, now hereby surrender publicly on this day Sunday January 31st 2010, all my properties, house and all amenities on the Waterworks Road known as the Adelaide & Frances Memorial Home For The Poor & Elderly along with this new facility, The "Johnson Memorial Home" and all its assets back to God via you my St. Lucian community." This declaration by one of the foremost individual advocates for elderly care in Saint Lucia saw a new phase in the management of facilities for the elderly.



Augustus Edwin Justin, father of Gusphyl Justin, NRC Associate at NRL

The Augustus Edwin Justin Foundation, registered in January 2005, will now take over administration of all the Adelaide's Homes, which are intended to forever remain in public trust. Two directors, former judge Madam Suzie d'Auvergne and financier George Theophilus have already been appointed.

The announcement came during the official opening of the Johnson Memorial Home for the Elderly on lower Morne Road. The former <u>Retreat House</u> of the late James and Josephine Johnson is one of the few remaining Town Houses from the late 19th Century. It was extensively repaired and renovated with eight bedrooms, four washrooms, sitting and T.V. room, a <u>Great</u> <u>Room</u>, prayer nook, balcony and service rooms. A separate building, <u>Gus-Care Cottage</u>, is the first of many planned for the 2 acre elder care village.

Bernard Johnson's and the Johnson family's donation of the historical property is a significant statement of altruism and a declaration of trust. *"Bernard just told me 'We did it!" and there were tears in his eyes,"* recalls Mr. Justin.

Administrator of the Adelaide's and later the Adelaide & Frances Memorial Home for the Elderly, Mr. Justin has meaningfully impacted elderly care in Saint Lucia; highlighting the need for holistic care that includes social interaction and recreation

This was in evidence with the presence of friends from Martinique and Dominica, including singer Opehelia Marie. The Johnson and Justin families welcomed almost 700 invited guests from all walks of life to the ceremony, which was blessed by Monsignor Patrick Anthony. Government and opposition were represented by Guy Mayers, Phillip J. Pierre, Robert Lewis, and Vaughan Lewis.

Marking the twenty-fifth anniversary of the homes named for his late mother and sister, Mr. Justin said, "Today marks the greatest day of my life, and may be the accomplishment of all my dreams...I made a pledge to my God that I would be on a mission for Him to continue building comfortable living conditions for our poor and elderly and to leave behind monuments of love for our future generations. But, like every spiritual assignment the road has been rough and tedious." Gusphyl Justin, NRC Associate at the Naval Research Laboratory (NRL), testified that, "the journey has come with many lost friendships and untold financial burdens...But it was obvious he felt he was doing the right thing." Justin's eldest son Andre also paid tribute to his father, sharing memories of his father praying with and putting them to bed even with his demanding tasks.

Augustus Justin recognized the many altruistic individuals and organizations that have supported his vision over the past twenty-five years noting, "*This little exercise here today is not just another show, but that of showing hands of how many of us are prepared to make the little sacrifice to help solve the social problems which are fast engulfing our nation with greed, selfishness, envy and now violence.*"



Sending a message to all Saint Lucians, Mr. Justin added, *"We must break that* cycle of bad and evil which have been plaguing our country and replace it with goodness and love. Together we can shine our light in the dark areas of this country."

Gusphyl Justin, NRC Associate, NRL

Spring-Summer 2010

Agencies / Laboratories Participating in the NRC Research Associateship Programs

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U.S. Army Research Laboratory	ARL
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2010 SCHEDULE

February Review

Submission deadline - February 1 Transcripts and Reference Reports deadline - February 15 The Board meets March 9—10 Agencies will be notified within two weeks

May Review

Submission deadline - May 1 Transcripts and Reference Reports deadline - May 15 The Board meets on June 18 Agencies will be notified within two weeks

August Review

Submission deadline - August 1 Transcripts and Reference Reports deadline - August 15 The Board meets on September 24 Agencies will be notified within two weeks

November Review

Submission deadline - November 1 Transcripts and Reference Reports deadline - November 15 The Board meets on January 5, 2011 Agencies will be notified within two weeks

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