THE NATIONAL ACADEMIES

RESEARCH ASSOCIATESHIP PROGRAMS

NEWSLETTER

Spring 2008

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NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

The Story of TAO

"...the crowning achievement of TOGA was the development of the Tropical Atmosphere/Ocean (TAO) array..." EOS Transactions, American Geophysical Union, 78(1), 7 January 1997.

The TAO array (renamed the TAO/TRITON array on 1 January 2000) consists of approximately 70 moorings in the Tropical Pacific Ocean, telemetering oceanographic and meteorological data to shore in real-time via the Argos satellite system. The array is a major component of the El Niño/Southern Oscillation (ENSO) Observing System, the Global Climate Observing System (GCOS) and the Global Ocean Observing System (GOOS). Support is provided primarily by the United States (National Oceanic and Atmospheric Administration) and Japan (Japan Agency for Marine-earth Science and Technology) with additional contributions from France (*Institut de recherche pour le developpement*).

After most of the work was done on a cruise in September 2006 between Nuku Hiva, French arquesas and Honolulu on the NOAA Ship Ka'imimoana (Hawaiian for "Ocean Seeker"), the Commanding Officer presented NOAA Scientist and NRC Adviser, Dr. Mike McPhaden, with a cake in the likeness of their signature oceanic buoy, referred to as ATLAS. The ATLAS array across the Pacific has revolutionized the study of El Nino and La Nina by providing data in real time to advance climate research and forecasting.

C.O. presents Dr. Mike McPhaden with buoy cake

NOAA profile of Dr. McPhaden on page 8.

http://www.pmel.noaa.gov/tao/proj_over/proj_over.html
http://www.pmel.noaa.gov/tao/kaimi/gp205/gp205photos.shtml

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

The NRC Research Associateship Programs *Newsletter* is published semi-annually (spring and autumn) to highlight research and activities of NRC Associates and Advisers who participate in the programs in our many agencies and laboratories. It is posted on this web page in full-color PDF. In addition, the monochrome version is printed by the National Academy Press (NAP), and bulk orders of 10 or more are available from our office for bulk distribution at agencies/laboratories, scientific meetings, NRC meetings, staff visits, site visits, etc. March 1 and September 1 are the tentative deadlines for submission of articles to the respective spring and autumn issues. However, 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.

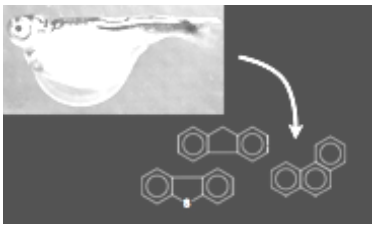
Send all submissions to Suzanne White (swhite@nas.edu)

New Findings on Emerging Contaminants

Chemicals in our waters are affecting human and aquatic life

American and Canadian scientists are finding that out of sight, out of mind can no longer be the approach we take to the chemicals in our waters. Substances that we use everyday are turning up in our lakes, rivers and ocean, where they can impact aquatic life and possibly ourselves.

Derek Muir of Environment Canada and colleagues have determined that of the 30,000 or so chemicals used commercially in the United States and Canada, about 400 resist breaking down in the environment and can accumulate in fish and wildlife. These researchers estimate that of this 400, only 4 percent are routinely analyzed and about 75 percent have not been studied. These "emerging chemical contaminants," or ECCs, are not necessarily all new substances. But with improved detection technologies, their unexpected potential impacts on the environment and human health are just now coming to light.



Chemical structure of a PAH compound and the abnormalities in a zebrafish exposed to the toxin

At a press conference at the Annual Meeting of the American Association for the Advancement of Science (AAAS) at the Sheraton Boston Hotel, 1 p.m. EST on Saturday, February 16, a panel of researchers will discuss their current findings about how ECCs are affecting aquatic environments and may be coming back to haunt us in unanticipated ways.

John Incardona and Nathaniel Scholz at National Oceanic and Atmospheric Administration's Northwest Fisheries Science Center and the West Coast Center for Oceans and Human Health found that polycyclic aromatic hydrocarbons (PAHs) left in Pacific waters after the *Exxon Valdez* oil spill caused heart defects in herring and pink salmon embryos. PAHs from various sources, including oil spills and urban runoff, remain a threat to fish in coastal areas. The scientists think these chemicals can cause the hearts of fish embryos to beat slower and slower, resulting in heart deformities and a buildup of fluid around the hearts. During the last six years, they tested the effects of PAHs on zebrafish, which medical researchers have determined to have systems comparable to those of humans. The zebrafish embryos' hearts were severely malformed after absorbing PAHs through their skin.

"What isn't good for them isn't good for us," Incardona says. Given the amount of PAH emissions that come out car tailpipes daily, especially in dense, urban areas, "basically, we are breathing an aerosolized oil spill." He says PAHs should be considered as "prime suspects for cardiovascular impacts related to air pollution."

Combining Chemicals can be Dangerous

Scholz is also finding that although the effects of a single chemical may not be deadly, combinations of chemicals in our environment can be more potent. Pesticides are regulated one by one, but in the environment they can mix with other pesticides and such mixtures are not regulated.

Water quality monitoring of rivers and streams has shown that threatened and endangered coho salmon and steelhead habitats throughout the Northwest are widely contaminated with pesticides that have run off from urban areas and agricultural land. The researchers looked at mixtures of five common insecticides and found that some combinations were much more toxic to the juvenile salmon than any one of the chemicals acting alone. The researchers say the enhanced toxicity of pesticide mixtures could be a more important factor in salmon population declines than previously realized.

"Current risk assessments based on a single chemical will likely underestimate impacts on wildlife in situations where that chemical interacts with other chemicals in the environment," says Scholz. The current findings may have implications for human health because these insecticides act on the nervous systems of salmon and humans in a similar way. Also, mixtures of pesticide residues can be common in the human food supply.

Turtles Show Toxic Chemicals Persist in the Marine Environment

Stain repellents for carpets and nonstick coatings on food packaging derived from compounds known as perfluorinated compounds, or PFCs, are tough. But the same toughness that helps PFCs resist spills and grease also makes them resistant to breaking down in the environment. This means that PFCs can easily contaminate bodies of water and be ingested by wildlife.

Jennifer Keller of the National Institute of Standards and Technology (NIST) and the Hollings Marine Laboratory in Charleston, S.C., and her colleagues have monitored PFCs in loggerhead sea turtles along the U.S. East Coast to study the effects of the pollutants on these marine animals. Loggerhead turtles accumulate PFCs in their tissues because they eat filter feeders such as mussels that remove contaminants from the water.

Keller's team found that turtles with high concentrations of PFCs showed signs of liver damage and were immunocompromised. Keller says, "Endangered sea turtles run a gauntlet of stresses in the oceans, and chronic exposure to contaminants may impair their defenses against disease or their ability to reproduce." Because reptiles and humans have similar immune systems, Keller says that we also may be at risk for the same health problems as the loggerheads from exposure to PFCs.

Gender Bending can Impact Aquatic Food Webs

Chemicals are ending up in aquatic ecosystems in part because many municipal wastewater treatment plants do not filter out chemicals completely, including the estrogen women excrete in their urine after taking birth control medications. Karen Kidd of the University of New Brunswick is testing the effects of estrogen on aquatic life in a laboratory a bit larger than usual—a lake in northwestern Ontario.

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Washington, DC metro area 2007 Career Fair held at NIST

Every year, hundreds of post-doctoral fellows working in Washington, DC area federal and university labs finish their fellowships and drift off to other areas of the country to find jobs. Many of them have established roots locally, but are unaware of local professional opportunities. To address that issue, and in an attempt to hold onto a phenomenal workforce resource, the 2007 Post-Doc Conference and Career Fair was held on June 27 at the National Institutes of Standards and Technology. This second annual conference introduced over 420 post-doctoral fellows (most from federal labs) to local career options including employment with large companies, small entrepreneurial startups, government agencies, and non-profits. Fellows were exposed to possibilities that ranged from traditional bench work to policy analysis to patent and trademark work to founding companies that commercialize technologies from federal labs.

Post-docs also learned interviewing skills, had their resumes reviewed, and participated in a career fair with 37 hiring companies and a number of resources including the Kauffman Foundation for Entrepreneurship, AAAS/ ScienceCareers.org, and FASEB Career Resources. In assessment surveys, a typical post-doc comment was, "This was an excellent information gathering event and really opened my eyes to the opportunities that are available in this region."

One of the more remarkable facets of the Post-Doc Conference is the collection of organizations that participated in the planning process. Rockville Economic Development, Inc. served as overall conference organizer. MDBIO, the NIH Office of Technology Transfer, the National Research Labs, the **National Research Council of the National Academies of Science**, the National Cancer Institute Tech Transfer Office, NIST, USAMRIID, NASA, the Federal Lab Consortium, George Mason University, and the George Washington University SEAS Council of Entrepreneurial Tech Transfer and Communication all helped structure the program, and publicized the event to postdoctoral fellows. The Association for the Advancement of Science (AAAS)/Science Careers.org put together part of the program and publicized the conference. The state of Maryland participated through the Maryland Technology Development Corporation (TEDCO) and the Department of Workforce Development's Professional Outplacement Assistance Center. Montgomery County participation was provided by the Montgomery County Department of Economic Development, and Montgomery County Workforce Services. The Tech Council of Maryland coordinated the registration and logistics. Financial support was provided by the Kauffman Foundation, the Maryland Dept. of Business and Economic Development, MDBio, the Montgomery County DED, Montgomery Works, NIST, TEDCO, BAE Systems, the Defense Threat Reduction Agency, George Mason University, Goldbelt Raven, Intervise, the National Geospatial-Intelligence Agency, U.S. Pharmacopeia, AAAS, the FLC, Lockheed Martin, SAIC Frederick, CNSI, Human Genome Sciences, IASTA, the NRL, Origene Technologies, Social and Scientific Systems, the USPTO and USAMRIID. This association of government and scientific agencies is so unusual that it and the project are being held up as national models by AAAS.

This successful event is testament to the results collaboration between federal labs, state and local government, and the private sector can produce. For further information or to participate in the 2008 Post-Docs Conference, contact Rockville Economic Development, Inc. at 301-315-8096 or info@RockvilleREDI.org.

Former NRC Senior Associate — Shanti Swarup Bhatnagar Prize

Dr. Anil Bhardwaj, former NRC Senior Research Associate at NASA Marshall Space Flight Center, was awarded the Shanti Swarup Bhatnagar Prize for the year 2007 in the discipline "Earth, Atmosphere, Ocean and Planetary Sciences" for pioneering contributions in the field of Planetary and Space Science. In addition to the other scientific contributions, Bhardwaj is cited for his fundamental contributions and creative ideas in the field of planetary X-rays and international collaborative research.

The Shanti Swarup Bhatnagar prize, the most coveted, and the highest award for young (below 45 years of age) scientists and engineers in India, is given by the Indian Council of Scientific and Industrial Research (CSIR) for outstanding contributions to the field of Science and Technology. The prize comprises of a citation, a plague, and a cash award of Rs. 2,00,000 (Rupees Two Hundred Thousand) and is given by the Honorable Prime Minister of India at a formal function.

Anil Bhardwaj says, "*It's a great recognition for my work, a grand tribute to Planetary Science community in India, and a rich compliment to the Space Physics Laboratory (SPL), the Vikram Sarabhai Space Centre (VSSC), and the Indian Space Research Organization (ISRO). My NRC tenure at NASA MSFC has made an important contribution in my success. This tenure had been a wonderful experience for me, and it was a sheer delight working with Dr. Ron Elsner, my* ***NRC Advisor****.*

NRC Adviser, Ron Elsner

I must say that the NRC Resident Research Associateship program is a very useful program and I am blessed by it."

According to **NRC Adviser, Dr. Ron Elsner,** *"Anil's time at MSFC proved to be a very productive period of research and collaboration.. He is a very knowledgeable and energetic researcher with many useful ideas. Working with our team of planetary X-ray observers, he greatly multiplied our productivity and broadly disseminated our work in the science community. In my opinion, Anil's tenure at MSFC was an excellent example of how international collaboration and NASA's Postdoctoral Program works. He richly deserves the prize he has been awarded."*

Dr. Anil Bhardwaj, former NASA Marshall Space Flight Center NRC Senior Research Associate

See NRC RAP Newsletter, autumn 2005, page 15 for article on Dr. Anil Bhardwaj work's during NRC tenure at NASA MSFC.

A Brief Profile of Dr. Anil Bhardwaj: Dr. Anil Bhardwaj earned the M.Sc. (Physics) from Lucknow University in 1987 and Ph.D. in Applied Physics (Planetary and Space Science) in 1992 from the Institute of Technology, Banaras Hindu University, Varanasi. He joined the Indian Space Research Organization (ISRO) in August 1993 as Scientist and was posted at Space Physics Laboratory (SPL) of the Vikram Sarabhai Space Center (VSSC), Trivandrum. He is currently a Senior Scientist and is heading the Planetary Sciences Branch of SPL, VSSC.

Dr. Bhardwaj was a **NRC Senior Research Associate** at NASA Marshall Space Flight Center, Huntsville, during 2004 and 2005—a distinguished planetary scientist of international repute. His field of research is theoretical and observational studies of planetary atmospheres and ionospheres, and their coupling with magnetospheric plasma and solar wind. Topics of his current research interest are: planetary X-ray astronomy, aurora and airglow processes and emissions, chemistry of cometary coma, Io and Io-Jupiter interactions, Monte Carlo simulation of charged particle degradation in planetary atmospheres, solar wind-lunar interaction, ENA imaging of the lunar surface and Earth's magnetosphere-ionosphere system, and comparative planetology. He is a multi-spectral (X-ray, UV, visible, radio) observer, a planetary mission experimenter, and a theoretical modeler.

Continued on next page

MSFC

Bhardwaj continued

Dr. Bhardwaj is the Indian Principal Investigator of the joint Indo-Swedish SARA (Sub-keV Atom Reflecting Analyzer) experiment on Chandrayaan-1. He has been the Co- and Principal-Investigator on observation programs with Chandra and XMM-Newton X-ray Observatories, HST, and Giant Meterwave Radio Telescope (GMRT) of India. He is a member of the Indian multi-wavelength ASTROSAT mission, and a Team Leader of International Heliophysical Year-Coordinated Investigation Program (CIP3). He is a Core Team member of ISRO's small satellite program SENSE and of the Mars and Chandrayaan-2 mission study group. He has also made significant contributions towards the growth of planetary science in his country.

Dr. Bhardwaj has written a Chapter in "*Encyclopedia of the Solar System*" (2007), has edited 2 books (Editor-in-chief of *Advances in Geosciences*, Vol. 3 (2006) and vol. 7 (2007), published by World Scientific, Singapore), and has written invited reviews for reputed international journals. He has authored more than 60 refereed research papers in international journals in the field of planetary and space physics. His research publications have made *cover page* of journals, and one of his papers in *Geophysical Research Letters* is selected as the "AGU Journal Highlights". He has presented over 100 research papers at conferences in India and abroad, including several invited talks. He has been the convener of several special sessions at international conferences on topics related to planetary science. He has delivered invited talks/colloquium at several major Institutes in the world, including, Caltech, JPL, NASA, Southwest Research Institute, Boston Univ., Univ. Virginia, Univ. College London, Rutherford Appleton Lab. (UK), Inst. of Space Physics (IRF, Sweden), ESTEC (Netherlands), LPAP (Belgium), and many others. His collaborative research programs span over 30 research institutes in India, USA, Europe, and Asia.

Dr. Bhardwaj is the elected President of *Planetary Science* Section of *Asia Oceania Geosciences Society* (AOGS). He is the Editor-in-chief of '*Advances in Geosciences*', and a Member of the Editorial Board of the European journal *Planetary and Space Science*. He is a life member of Astronomical Society of India and Kerala Academy of Sciences, and a member of American Geophysical Union. He is a member of several ISRO and national level committees related to Planetary and Space Sciences research programs in India. One Ph. D. and two M. Tech. theses, one MS thesis from MIT (USA), and several MS projects, have been awarded under his guidance. Dr. Bhardwaj's research findings have led to several Press Releases by NASA and ESA. See NRC RAP Newsletter, autumn 2005, page 15, for article on Dr. Anil Bhardwaj's work during NRC tenure at NASA MSFC.

To know more about Dr. Bhardwaj and his work Google key word ["Anil Bhardwaj + X-rays"]. His current address is: Space Physics Laboratory, Vikram Sarabhai Space Center, Trivandrum 695022, INDIA, Anil_Bhardwaj@vssc.gov.in ; Tel +91-471-256-2330; Fax +910471-2706535.

Ten (10) fingerprints to be required at some airports for foreign visitors

Starting next week, the Homeland Security Department will begin requiring foreigners who fly into certain U.S. airports to have 10 fingerprints scanned as part of an upgraded security system.

The department will require foreigners arriving at Washington Dulles International Airport outside of Washington, D.C., to provide 10 fingerprints under an expanded version of the US-VISIT migrant-tracking system. The system will be deployed at nine other airports by next March, a US-VISIT spokeswoman said.

Foreigners previously have been required to have only two fingerprints scanned into the system, which compares that biometric information to government watch lists in order to identify potential terrorists, criminals or people who have violated immigration laws.

The transition to 10 fingerprints has been years in the making. Critics have noted that US-VISIT is not fully compatible with the FBI's integrated fingerprint database, which uses 10 prints. Additionally, the State Department is using 10-fingerprint scanners at most of its visa-issuing centers around the world.

"The transition from collecting two digital fingerprints to collecting 10 fingerprints from international visitors is one of the department's top priorities because it furthers the department's ability to keep dangerous people out of the United States while making legitimate travel more efficient," the department said in a statement.

The spokeswoman said Homeland Security has begun a public relations campaign to inform international travelers of the new procedures and does not expect wait times at airports to increase. "We're working on doing this in a way that doesn't impede travel," she said.

She noted that US-VISIT has been operating for four years, so foreigners are accustomed to having fingerprints scanned. "We've had that experience behind us, so this is not new," she said.

Homeland Security awarded contracts to CrossMatch Technologies and Identix Identification Services to supply 10-fingerprint scanners, the spokeswoman said. Identix has since become L-1 Identity Solutions.

The department plans to evaluate how the scanners are operating at the airports in March and select one of the companies to continue supplying scanners.

According to the department's schedule, the upgraded US-VISIT system will be deployed at 107 other airports by Dec. 31, 2008. Additionally, the department will begin collecting 10 fingerprints of international travelers at seaports and land ports by that date. The system is only used during secondary screening procedures at land crossings.

By Chris Strohm *National Journal's Technology Daily* November 27, 2007

Presidential Early Career Award for Scientists and Engineers

Dr. Mark Scheuerell, former NRC Associate at the NOAA National Marine Fisheries Service laboratory in Seattle (2002-2003), and current NOAA Adviser at the same laboratory was one of fifty-five recipients of the 2006 Presidential Early Career Award for Scientists and Engineers. This award ceremony, presided over by John H. Marburger III, Science Advisor to the President and Director of the White House Office of Science and Technology Policy, reflects the Nation's highest honor for professionals at the outset of their independent scientific research careers.

The Presidential Early Career Awards for Scientists and Engineers, established in 1996, honors the most promising researchers in the Nation within their fields. Nine federal departments and agencies annually nominate scientists and engineers who are at the start of their independent careers and whose work shows exceptional promise for leadership at the frontiers of scientific knowledge. Participating agencies award these talented scientists and engineers with up to five years of funding to further their research in support of critical government missions.

The recipients of the 2006 Presidential Early Career Awards for Scientists and Engineers, along with their nominating federal department or agency were:

Department of Agriculture
Douglas D. Bannerman, USDA Agricultural Research Service
Sarah D. Brooks, Texas A&M University
Samuel A. Cushman, USDA Forest Service

Department of Commerce
Casey Brown, Columbia University
Mark Scheuerell, National Oceanic and Atmospheric Administration
Kathryn L. Beers, National Institute of Standards and Technology
Joshua C. Bienfang, National Institute of Standards and Technology

Department of Defense
Odest C. Jenkins, Brown University
Kenneth C. Slatton, University of Florida
Jonathan E. Spanier, Drexel University
Jacob L. Roberts, Colorado State University
Krystyn J. Van Vliet, Massachusetts Institute of Technology
Jelena Vuckovic, Stanford University

Department of Education
Carol McDonald Connor, Florida State University

Department of Energy
Brian J. Kirby, Cornell University
Jeffrey Kysar, Columbia University
Carols Pantano Rubino, University of Illinois
Shawn Newsam, University of California, Merced
Kyle Cranmer, Brookhaven National Laboratory
Julia Laskin, Pacific Northwest National Laboratory
Ho Nyung Lee, Oak Ridge National Laboratory
Len A. Pennacchio, Lawrence Berkeley National Laboratory

Department of Health and Human Services: National Institutes of Health
Katrina Akassoglou, University of California, San Diego
Jeanmarie Houghton, University of Massachusetts
Jay R. Hove, University of Cincinnati
Sven-Eric Jordt, Yale University
Susan M. Kaech, Yale University
Bruce D. McCandliss, Cornell University
Alexandra C. McPherron, National Institutes of Health
Gus R. Rosania, University of Michigan
J. Peter Rubin, University of Pittsburgh
Ravindra N. Singh, Iowa State University
Michelle P. Winn, Duke University
Adam T. Woolley, Brigham Young University

National Aeronautics and Space Administration
Olivier Guyon, University of Hawaii, Subaru Telescope
Matthew Rodell, Goddard Space Flight Center

National Science Foundation
Sonya Bahar, University of Missouri-ST. Louis
Bahar Biller, Carnegie-Mellon University
Matthew J. Fouch, Arizona State University
Eric C. Greene, Columbia University
Pradeep R. Guduru, Brown University
Jenefer Husman, Arizona State University
Dean S. Karlan, Yale University
Brian G. Keating, University of California, San Diego
Kiran Kedlaya, Massachusetts Institute of Technology
Edward Kohler, University of California, Los Angeles
J. Nicholas Laneman, University of Notre Dame
Chekesha M. Liddell, Cornell University
Elliot Moore II, Georgia Institute of Technology
Amy J. Pruden-Bagchi, Colorado State University
Carlos Rinaldi, University of Puerto Rico, Mayaguez
James P. Schmiedeler, Ohio State University
Ahna Skop, University of Wisconsin
Yi Tang, University of California, Los Angeles
Joseph W. Thornton, University of Oregon, Eugene
Lisa M. Zurk, Portland State University

Department of Veterans Affairs
Sterling C. Johnson, William S. Middleton VA Hospital
William S. Yancy, Jr., Durham VA Medical Center

NOAA

Prototype for long wavelength array sees first light

Astronomers at NRL have produced the first images of the sky from a prototype of the Long Wavelength Array (LWA), a revolutionary new radio telescope to be constructed in southwestern New Mexico. The images show emissions from the center of our Galaxy, a supermassive black hole, and the remnant of a star that exploded in a supernova over 300 years ago. Not only a milestone in the development of the LWA, the images are also a first glimpse through a new window on the cosmos. "First Light" is an astronomical term for the first image produced with a telescope. It is a key milestone for any telescope because it indicates that all of the individual components are working in unison as planned.

Once completed, the LWA will provide an entirely novel view of the sky, in the radio frequency range of 20–80 MHz, currently one of the most poorly explored regions of the electromagnetic spectrum in astronomy. The LWA will be able to make sensitive high-resolution images, and scan the sky rapidly for new and transient sources of radio waves, which might represent the explosion of distant, massive stars, the emissions from planets outside of our own solar system or even previously unknown objects or phenomena.

"The LWA will allow us to make the sharpest images ever possible using very long wavelength radio waves. This newly opened window on the universe will help us understand the acceleration of relativistic particles in a variety of extreme astrophysical environments including from the most distant supermassive black holes. But perhaps most exciting is the promise of new source classes waiting to be discovered," says Dr. Namir Kassim, an NRL astronomer and **NRC Adviser** in the Remote Sensing Division and LWA Project Scientist.

Dr. Tracy Clarke, Interferometrics, Inc., Herndon, Virginia, another astronomer on the NRL team adds, *"By detecting distant clusters of galaxies the LWA may also provide new insights on the cosmological evolution of the mysterious dark matter and dark energy."*

Although radio astronomy was discovered at low frequencies (near 20 MHz, corresponding to wavelengths of 15 meters), well below the current FM band, astronomers quickly moved up to higher frequencies (centimeter wavelengths) in search of higher resolution and to escape the corrupting effects of the Earth's ionosphere, a region of charged particles between about 50 and 600 miles above the surface.

The ionosphere, which can "bend" radio waves to produce long-distance reception of AM and short-wave radio signals, also causes distortions in radio telescope images in much the same way that atmospheric irregularities cause twinkling of stars. Ionospheric effects become much worse at low frequencies, but new imaging techniques developed at NRL and elsewhere have allowed the "ionospheric barrier" to be broken and enabled high-resolution astronomical imaging at these low frequencies for the first time.

These new imaging techniques provide an improved view of not only the astronomical sky, but the Earth's ionosphere as well. The full LWA will generate richly detailed measurements of the ionosphere that will complement other ionospheric data sources. Understanding the ionosphere is critically important to the Department of Defense because of its effects on communications and navigation systems.

Fig. 1
Photograph of the 16-element LWDA, with a National Radio Astronomy Observatory Very Large Array (VLA) dish visible in the background. For scale, the individual LWDA antennas are a bit less than 4 feet tall and the largest separation between antennas in the array is about 70 feet. The telescope operates as a "phased array," in which the signals from each of the antennas are combined electronically (requiring no moving parts) such that the beam can point in a new direction or change observing frequency extremely quickly.

The current prototype, referred to as the Long Wavelength Development Array (LWDA) to differentiate it from the larger LWA project, completed installation on the Plains of San Agustin in southwestern New Mexico the fall of 2006. Funded by NRL and built by the Applied Research Laboratories of the University of Texas, Austin (ARL:UT), the telescope consists of 16 antennas connected to a suite of electronics that combine the signals from each antenna.

Each antenna is only 4 feet tall and acts much like an old style television antenna, receiving radio waves from many different directions simultaneously. When combined, the data from the individual antennas is comparable to that from a more traditional dish style telescope with a diameter of 70 feet.

NRL Remote Sensing Division, Code 7200
NRL Space Science Division, Code 7600
Interferometrics, Inc., Herndon, Virginia

The antenna design, which resembles a household ceiling fan, with blades that have drooped down at an angle of 45 degrees, was conceived to allow the array to see the full sky and cover a wide range of frequencies with a single antenna *"The sophisticated digital electronics used in the LWDA allow it to change observing frequency or point in a new direction in an instant, and even allow it to look in two directions at the same time,"* says Dr. Paul Ray, an astrophysicist and **NRC Adviser at NRL**, who is overseeing the overall performance of the LWDA.

When completed, the LWA will operate in a similar manner, but on a much grander scale. Plans call for over 13,000 individual antennas, divided into 50 stations. These stations will be spread over a 250-mile area across New Mexico, and possibly beyond.

Dr. Ray explains, *"With so many antennas required for the final LWA, it is vital that we have a testbed on which we can demonstrate the performance of a small number of them before construction of the full LWA begins in earnest."* NRL's LWDA serves this purpose, allowing the astronomers and engineers to test the dipole antennas and related computer hardware and software on a small scale, before embarking on construction.

The LWA, funding for which is managed by the Office of Naval Research, is a project of the Southwest Consortium, led by the University of New Mexico, and including NRL, ARL:UT, and Los Alamos National Laboratory, with important contributions from Virginia Tech and cooperation from the National Radio Astronomy Observatory (NRAO). The NRAO is a facility of the National Science Foundation operated under cooperative agreement by Associated Universities, Inc.

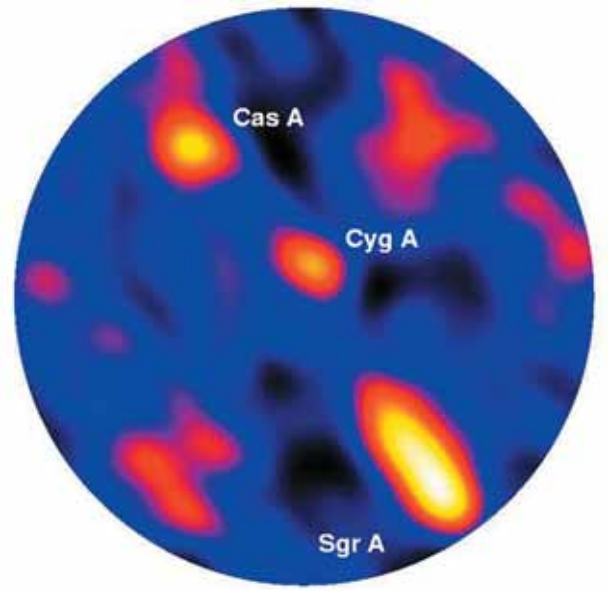


Fig. 2
Commissioning observations made this past fall by the LWDA show its all sky imaging capability. In this frame from the LWDA first light movie, emission from the bright sources Sagittarius A at the center of our Galaxy, Cassiopeia A, and the black-hole powered radio galaxy, Cygnus A, are all clearly visible. Cassiopeia A, the strongest discrete radio source visible in the sky, is a remnant of a massive star that exploded in a supernova over 300 years ago.

NRL

NOAA Profile: Dr. Michael McPhaden, NRC Adviser

Dr. Michael J. McPhaden is a Senior Scientist and **NRC Adviser** at NOAA's Pacific Marine Environmental Laboratory (PMEL) and an affiliate Professor in the School of Oceanography at the University of Washington in Seattle, Washington. He is also Director of the Tropical Atmosphere Ocean (TAO) Array Project Office at NOAA/PMEL. His research focuses on large-scale tropical ocean dynamics, ocean-atmosphere interactions, and the ocean's role in climate. For the past 25 years he has been involved in developing ocean observation systems in support of climate research and forecasting. The most notable of these observing systems is the TAO Array, which is a network of deep ocean moored buoys across the Pacific basin for the study of El Niño and La Niña.

He has also lead the development of similar arrays in the tropical Atlantic and Indian Oceans to study ocean-atmosphere interactions that affect the climate of countries surrounding those basins.

Michael received his Ph.D. in physical oceanography from the Scripps Institution of Oceanography at the University of California, San Diego in 1980. He spent two years (1980-82) as a Postdoctoral Fellow at the National Center for Atmospheric Research in Boulder, Colorado then took a research scientist position at the University of Washington in 1982. In 1986 he joined the Ocean Climate Research Division of NOAA/PMEL where he has been ever since.

Dr. McPhaden has published over 160 articles in the refereed scientific literature and has appeared in several TV productions featuring the TAO array. He has also been a member or chair of national and international science advisory committees sponsored by organizations such as the World Climate Research Program, the International Oceanographic Commission, and the U.S. National Academy of Sciences. He has received numerous awards and citations including a Department of Commerce Gold Medal, an American Meteorological Society Special Award for Contributions to Observing El Niño, and a Presidential Rank Award for Meritorious Federal Service. He is a Fellow of The Oceanography Society and the American Meteorological Society. Since 1990, Mike has hosted 6 NRC postdocs including the most recent who will arrive in April 2008.

[The American Geophysical Union (AGU) has elected Pacific Marine Environmental Laboratory's Dr. Mike McPhaden as the AGU President-Elect. This is quite an honor. AGU is the largest organization of professional geophysicists in the world, with over 50,000 members from 137 countries. Mike joins two of our other NOAA colleagues serving as President or President-Elect of major professional organizations: Dr. Tom Karl of the National Climatic Data Center is President-Elect of the American Meteorological Society, and OAR Assistant Administrator Dr. Rick Spinrad is President of The Oceanography Society. I am very pleased to see that National recognition of NOAA's role in promoting and producing preeminent research continues to grow.]

Navy initiates annual awards for top scientists and engineers of the year

The Navy's Top Scientists and Engineers of the Year awards, initiated in 2006 by Assistant Secretary of the Navy Dr. Delores Etter, are to be presented annually to Navy civilian and military personnel for exceptional scientific and engineering achievement within the preceding calendar year. To help encourage up-and-coming stars, a portion of the nominations are reserved for "Emerging Investigators" who contributed substantially during the year, have less than 10 years of government service, and "show unique promise for future excellence."

For 2006, both individual and team awards were bestowed in May 2007. Among the 40 recipients, approximately 20 were awarded to individuals, and the remainder were team awards. By carving out some of the awards for "Emerging Investigators," Dr. Etter wished to recognize the technical contributions of both the young and young-at-heart scientists and engineers across the DoN technical community.

The Navy Top Scientists and Engineers of the Year Award recognizes a technical achievement that occurred during the preceding year. Thus, the awards given in May 2007 were for a significant achievement during 2006. The awards presented in spring 2008 will be for achievements during 2007. This emphasis on a particular technical achievement is different from the usual service awards, which are given for sustained or lifetime achievements in science or engineering. Nominations for the 2007 awards will open soon.

A memo was be distributed to the Navy SYSCOM commanders, PEOs, warfare and systems center executive directors, and the technical director of NRL announcing the opening of the nomination process for the 2007 awards, including recognition of "Emerging Investigators." The criteria and nominating process was also described in the memo. There is no set number of awards to be given, but the nominee's technical achievement during 2007 should / will be noteworthy. Following is a list of the recipients of the inaugural 2006 awards and their home lab or warfare or systems center.

2006 Navy Top Scientists and Engineers

2006 Navy Top Scientists and Engineers

Dr. Jeffrey Heyer — NRL Washington, DC
Dr. Ruth P. Willis — NRL Washington, DC
Dr. Baochuan Lin — NRL Washington, DC
Dr. Joel Schnur — NRL Washington, DC
Dr. David Stenger — NRL Washington, DC
Dr. Anthony Malanoski — NRL Washington, DC
Mr. Joseph H. Frankovich — NRL Washington, DC
Mr. Anthony Tse — NRL Washington, DC
Dr. Ted A. Roberts — NRL Washington, DC
Mr. Stanley Chincheck — NRL Washington, DC
Dr. Charlie Barron — NRL Stennis Space Center, MS
Dr. Peter W. Gaiser — NRL Washington, DC
Dr. Daniel G. Gammon — NRL Washington, DC
Dr. Allan S. Bracker — NRL Washington, DC
Dr. Thomas L. Reinecke — NRL Washington, DC
Mr. Keith E. Lucas — NRL Washington, DC
Mr. Daniel A. Cook — NSWC Panama City, FL
Mr. Daniel C. Brown — NSWC Panama City, FL
Dr. John S. Stroud — NSWC Panama City, FL
Mr. Donald W. Johnson — NUWC Newport, RI
Mr. Joseph C. Burns — MCSC Quantico, VA
Mr. Lance Tracey — MCSC Quantico, VA
Dr. Roy Axford,Jr. SPAWAR, San Diego, CA
Mr. Jeff Waters — SPAWAR San Diego, CA
Mr. Christopher D. All SPAWAR Charleston, NC

Emerging Investigators

Mr. Brandon M. Cochenour — NAWC Patuxent River, MD
Mr. Robert E. Tompkins — NAWC China Lake, CA
Dr. Jennifer E. Prentice — NAWC Patuxent River, MD
Dr. Ahmed Amin — NUWC Newport, RI
Mr. Morris T. Fields — NAVSEA Washington Navy Yard
Dr. Joseph D. Neff — SPAWAR San Diego, CA
Dr. Richard L. Waters — SPAWAR San Diego, CA
Mr. Michael A.O. Thorpe — SPAWAR San Diego, CA
Ms. Estrellina B. Pacis — SPAWAR San Diego, CA
Dr. James H. Wynne, Jr. — NRL Washington, DC
Dr. Leonard M. Tender — NRL Washington DC
Dr. Pedro Jordan — NRL Stennis Space Center, MS
Dr. T.J.W. Lazio — NRL Washington, DC
Mr. James H. Rowell, Jr. — NRL Washington, DC
Mr. Jeffrey Geib — NRL Washington, DC

NRC Associates and Advisers bolded

NRL NRC Adviser, Dr. Elaine Oran, receives honorary doctorate from École Centrale de Lyon

Dr. Elaine S. Oran, Senior Scientist for Reactive Flow Physics at NRL, and **NRC Adviser**, has received an honorary degree from the École Centrale de Lyon (ECL), a prestigious French engineering school. They have conferred the honorific title "Docteur Honoris Causa of the ECL" on the basis of her influential path-breaking contributions to archival scientific literature and her outstanding service to the professional community. The degree was presented to Dr. Oran as part of the ECL's 150th anniversary celebration and is only the sixth honorary doctorate that ECL has ever given.

As Senior Scientist at NRL, Dr. Oran's current research includes development of numerical algorithms and the use of these algorithms in computerized models that describe a wide variety of complex fluid systems. These systems are used in research and applications ranging from microfluidics to astrophysics and cosmology. Her current work applies these simulation methods to design micron-sized devices for use in biosensors; design of micro-propulsion systems for use in air vehicles, space and planetary exploration; hazard reduction for the storage and handling of energetic materials including hydrogen fuels; basic physics of combustion processes involving flames; detonations and the transition to denotations; and explosions of supernovae.

Dr. Oran is responsible for programs sponsored by NRL, the Office of Naval Research (ONR), the National Aeronautics and Space Administration (NASA), and the Japanese research agency, NEDO. A substantial part of her work is involved with facilitating collaborations among government, academia, and industry. In addition to her work with ONR, Dr. Oran is a consultant to corporations and governmental agencies. Currently, she is at the center of a new collaboration among the U.S. government and a number of universities and private industries to design safe storage for hydrogen fuels. In addition to her professional responsibilities, Dr. Oran has extensively supported the Women in Science and Engineering (WISE) group within NRL.

Dr. Oran has authored and co-authored hundreds of technical papers and articles, as well as the highly regarded textbook, *Numerical Simulation of Reactive Flow*, which is considered to be the most widely used text on the subject. Dr. Oran has also served as visiting faculty member at several academic institutions, including Leeds University, England, and the University of Michigan, where she is adjunct professor of Aerospace Engineering, and the University of Wales at Aberystwyth, where she was Honorary Professor of Physics.

As a result of her mentorship, Dr. Oran has supervised the research of many Ph.D. students as well as hosted and directed the research of many national and international postdoctoral scholars at NRL. In 1979, Dr. Oran received the Arthur S. Fleming Award and in 1988 the WISE Award in Science, given for achievement in science by Women in Sci-ence and Engineering. In 1999, she received the Oppenheim Prize for "out-standing contributions to the theory of the dynamics of explosions and reactive systems."

In 2000, Dr. Oran received the Ya. B. Zeldovich Gold Medal, presented by the Russian Academy of Sciences for the Combustion Institute, and given for "outstanding contributions to the theory of combustion and detonations." In 2001 she became an honorary professor of the University of Wales. She was elected to the National Academy of Engineering in 2003 and is a Fellow of both the AIAA and the American Physical Society. In 2006, she received the Society of Women Engineers' Achievement Award.

Elaine is presently editor-in-chief of the AIAA Journal. She is president of the Institute for the Dynamics of Energetic and Reactive Systems, and has served on both the boards of directors of both the AIAA and the Combustion Institute. Additionally, she is past chair and a founding member of the American Physical Society Division of Computational Physics and has been active in the Division of Fluid Dynamics.

Dr. Oran received her A.B. degree in physics and chemistry from Bryn Mawr College; her M.Ph. degree in physics; and her Ph.D. degree in solid state physics and statistical mechanics.

NRL

World's top drug researchers unite to accelerate cures for TB, Malaria and HIV-AIDS

A group of leading drug researchers today announced the formation of a non-profit international institute to channel top talent and drug candidates from the world's leading research labs into a major, new global assault on tuberculosis (TB), malaria, and HIV/AIDS.

Founders of the International Drug Discovery Institute (iDDi) (www.i-ddi.org) hope to fill a gap in commercial drug development that has left large populations in developing nations exposed to epidemic diseases with no new or affordable cures. In effect, iDDi's innovative model seeks to skirt barriers that have hampered the development of new therapeutic agents for scourges like malaria or TB for the past 40 years.

"Through my long career in drug discovery, I have found it incredibly frustrating that every year, millions of human beings still perish from diseases that could and should be curable," said Dr. Alan Kozikowski, founder and chief science officer of iDDi. "We know that the world's best scientific minds -- collaborating on promising, new drug candidates — and empowered by new machine-based screening technologies, could launch a Manhattan-style project that would wipe these diseases from the face of the earth."

Explained John McCall, an iDDi director and former vice president of drug development at Pharmacia & Upjohn, Inc., "iDDi is the embodiment of this new approach to drug discovery and development. We will empower an innovative network of global scientific talent to break through organizational, national, and economic barriers to deliver new drugs more expeditiously to the people who need them."

IDDi is being formed specifically to accelerate drug discovery and development for neglected and orphan diseases, and has already begun outreach to major philanthropic foundations with similar goals. Its founders and collaborating scientists include research luminaries, such as Scott Franzblau, Ph.D., Director of the Institute for Tuberculosis Research at the University of Illinois at Chicago; **Geoff Dow**, Ph.D. a malaria researcher at the U.S. Army's Institute at Walter Reed Army Hospital; and Paul Wender, Ph.D., of Stanford University. **Geoff Dow, vide infra, was a WRAIR NRC Associate from 2000-2002.**

In addition to its technical resources, iDDi is developing a novel operational model aimed at making practical and affordable medicines available to those in need. To this end, Mohsen Marefat of The Althing Group has been retained to head the development and management of business operations for the Institute.

To date, iDDi has been funded by donations from angel benefactors. The Institute plans to launch an aggressive fundraising campaign to attract foundation support.

About iDDi : iDDi is a non-profit institute that will accelerate and streamline drug discovery by harnessing the power of technology and the expertise of select scientists, worldwide, to identify and bring to market effective and practical therapies for diseases afflicting millions. For more information, please visit www.i-ddi.org.

Contacts: International Drug Discovery Institute (iDDi) Nancy Rose Senich, 202-262-6996 nancy@rose4results.com

International Drug Discovery Institute (iDDi) pioneers new network of experts to address priority diseases

DDI's mission: optimize control of clinical trials

Over the past decade, clinical trials have grown in numbers, size and complexity, and at the same time they have been subject to increasing scrutiny and tightened regulations worldwide.

Clinical trials have become hugely expensive, and the need to control them very tightly has become more acute than ever before. The number of published trial results has increased two-fold from just above 700 in 2000 to almost 1500 in 2003.

Somewhat disparagingly, however, the number of new drug approvals has actually decreased over the same period, from 160 in 2000 to a mere 115 in 2002!

With the number of new molecular entities ready to enter clinical development over the coming years, it will be crucial to control trials as early as possible in order to screen the best drug candidates reliably and expeditiously.

The most efficient way to control clinical trials is to make the best possible use of statistical methodology for their design and analysis, and of technology for their conduct. This is IDDI's mission.

IDDI's scientific advisory board function

- Help **IDDI** define strategic objectives for the coming years
- Provide independent review of **IDDI**'s scientific activities
- Intervene as required, in a consulting capacity, in various areas of expertise

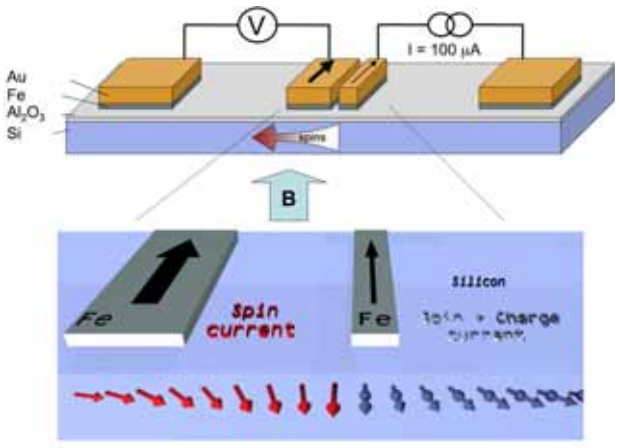
Members of the **Scientific Advisory Board** are opinion leaders with vast experience in their respective areas of expertise. At the time of writing, the Board includes:

- Dr William Blackwelder, biostatistics, US
- Prof Harry Bleiberg, oncology, Belgium
- Dr Jay Herson, biostatistics, US
- Prof Geert Molenberghs, biostatistics, Belgium
- Dr Steven Wright, drug development, UK

NRL NRC scientists demonstrate generation, modulation and electrical detection of pure spin currents in silicon

NRC Associates and Advisers at the Naval Research Laboratory (NRL) have generated, modulated and electrically detected a *pure spin current* in silicon, the semiconductor used most widely in the electronic device industry. Magnetic contacts on the surface of an n-type silicon layer enable generation of a spin current which flows separately from a charge current. The spin orientation is electrically detected as a voltage at a second magnetic contact. The relative magnetizations of these contacts allow full control over the orientation of the spin in the silicon channel. This was accomplished in a lateral transport geometry using lithographic techniques compatible with existing device geometries and fabrication methods. This demonstration by NRL scientists is a key enabling step for developing devices which rely on electron spin rather than electron charge, an emergent field known as "semiconductor spintronics." Progress in this field is expected to lead to devices which provide higher performance with lower power consumption and heat dissipation. The complete findings of this study, titled "Electrical injection and detection of spin-polarized carriers in silicon in a lateral transport geometry," are published in the 19 November 2007 issue of *Applied Physics Letters.*

The electronics industry has relied largely on the control of charge flow, and through size scaling (i.e. reducing the physical size of elements such as transistors) has continuously increased the performance of existing electronics. However, size scaling cannot continue indefinitely as atomic length scales are reached, and new approaches must be developed. Basic research efforts at NRL and elsewhere have shown that spin angular momentum, another fundamental property of the electron, can be used to store and process information in metal and semiconductor based devices.



The illustration shows the lateral device with the non-local detection, which was used to demonstrate the electrical injection, detection and modulation of spin current in silicon. A charge current of spin-polarized electrons follows the applied voltage and flows to the right, while a pure spin current flows to the left.

The 2007 Nobel Prize in Physics was awarded for the discovery of giant magnetorsistance, a phenomenon based upon spin-polarized electron currents in metals. This research moved from discovery in 1988 to commercial products in approximately 10 years, and is credited with the availability of low-cost, high density hard disk drives which are widely found in consumer products ranging from computers to video games and hand-held electronics. The spin angular momentum of electrons can be used to store and process information in semiconductor devices just as in metals. Indeed, the International Technology Roadmap for Semiconductors (ITRS) has identified the use of the electron's spin as a new state variable that should be explored as an alternative to the electron's charge. The use of pure spin currents to process information is regarded as the "holy grail" of semiconductor spintronics, as it frees one from the constraints of capacitive time constants and resistive voltage drops and heat buildup which accompany charge motion.

Much of the initial research success in this field was achieved in III-V semiconductors with a direct band gap such as gallium arsenide, where powerful optical spectroscopic techniques are relatively easy to apply and enable detailed insight into the behavior of the spin system. Significant strides have recently been made by NRL scientists to utilize spin transport in silicon, an indirect gap material, as they demonstrated efficient injection of spin-polarized electrons from a ferromagnetic metal contact (Nature Physics 3, 542 (2007)). They have now taken an important step towards the realization of a functional silicon spintronic device. In this very recent work, NRL scientists first inject a spin polarized electrical current from a ferromagnetic iron / aluminum oxide tunnel barrier contact into silicon, which generates a *pure spin current* flowing in the opposite direction (see figure). This spin current produces shifts in the spin-dependent electrochemical potential, which can be electrically detected outside of the charge path at a second magnetic contact as a voltage. The NRL team showed that this voltage is sensitive to the relative orientation of the spin in the silicon and the magnetization of the detecting contact . They further showed that the orientation of the spin in the silicon could be uniformly rotated by an applied magnetic field, a process referred to as coherent precession, demonstrating that information could be successfully imprinted into the spin system and read out as a voltage. The generation of spin currents, coherent spin precession and electrical detection using magnetic tunnel barrier contacts and a simple lateral device geometry compatible with "back-end" silicon processing will greatly facilitate development of silicon-based spintronic devices.

The NRL research team includes Dr. Olaf van't Erve, Dr. Berend Jonker (**NRC Adviser and former NRC Associate)**, Drs. Aubrey Hanbicki, Connie Li, Mike Holub and Chaffra Awo-Affouda (**NRC Associates),** Materials Science and Technology Division, and Phillip Thompson, Electronics Science and Technology Division. This work was supported by NRL core programs, the NRC Program, and the Office of Naval Research. In addition, this group won the Alan Berman Research Publication award in 2007 for the paper.

NRL

NRL scientists analyze Comet Wild 2 samples

Scientists at the Naval Research Laboratory (NRL) have analyzed samples from Comet Wild 2, as part of NASA's Stardust mission, the first solid sample return mission since Apollo. Over one hundred scientists at various institutions participated in the preliminary analysis. NRL contributed to the Mineralogy and Petrology, Crater, Bulk Chemistry and Isotope analysis teams by studying the structure and composition of the comet samples using transmission electron microscopy (TEM).

The TEM studies carried out by Dr. Rhonda Stroud, NRL **NRC Adviser,** and Dr. Thomas Zega, NRL **NRC Associate**, from NRL's Materials Science and Technology Division, demonstrated that micrometer-sized Mg-rich silicates and nanoscale Fe-sulfides are primary components of the cometary material. The samples studied at NRL included both grains captured in aerogel (Figure 1) and aluminum foil (Figure 2).

Comparative analysis of samples collected in each media is important for distinguishing the primary characteristics of the cometary grains from capture artifacts. To conduct these studies, the NRL researchers made use of world-class TEM and focused-ion-beam microscopy (FIB) facilities maintained by the Materials Science and Technology Division and the Nanoscience Institute. FIB techniques for extracting the micrometer-sized cometary residue from foil craters were developed at NRL with support from the NASA SRLIDAP program.

Stardust was the first NASA mission dedicated to exploring a comet. The mission robotically collected comet samples in deep space and returned them to earth. Stardust passed within 149 miles of Comet Wild 2 in January 2004. The spacecraft passed Comet Wild 2 at 13,000 mph, over six times faster than a speeding bullet. The thousands of comet particles were captured using a material called aerogel, which is a special type of foamed glass, made so lightweight that it is barely visible and almost floats in air. Most of the particles collected are smaller than the width of a human hair. To collect the comet samples, Stardust traveled two-billion miles to meet Comet Wild 2 and then another one-billion miles to get back home. The samples returned to Earth in January 2006, and the preliminary analysis was conducted until August. The preliminary results appear in the December 15 issue of Science. Continued analysis of more of the Stardust cometary samples is ongoing.

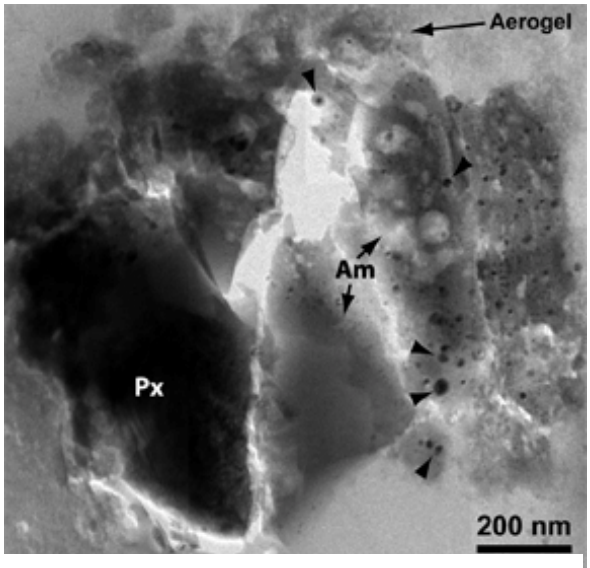


Figure 1
Bright-field TEM image of a mineral assemblage from Comet Wild 2. Mg-rich silicates, such as pyroxene (MgSiO3; Px) are intermixed with amorphous silicates (Am) and nanoscale Fe-Ni sulfides (black arrowheads). The aerogel capture material occurs around the assemblage.

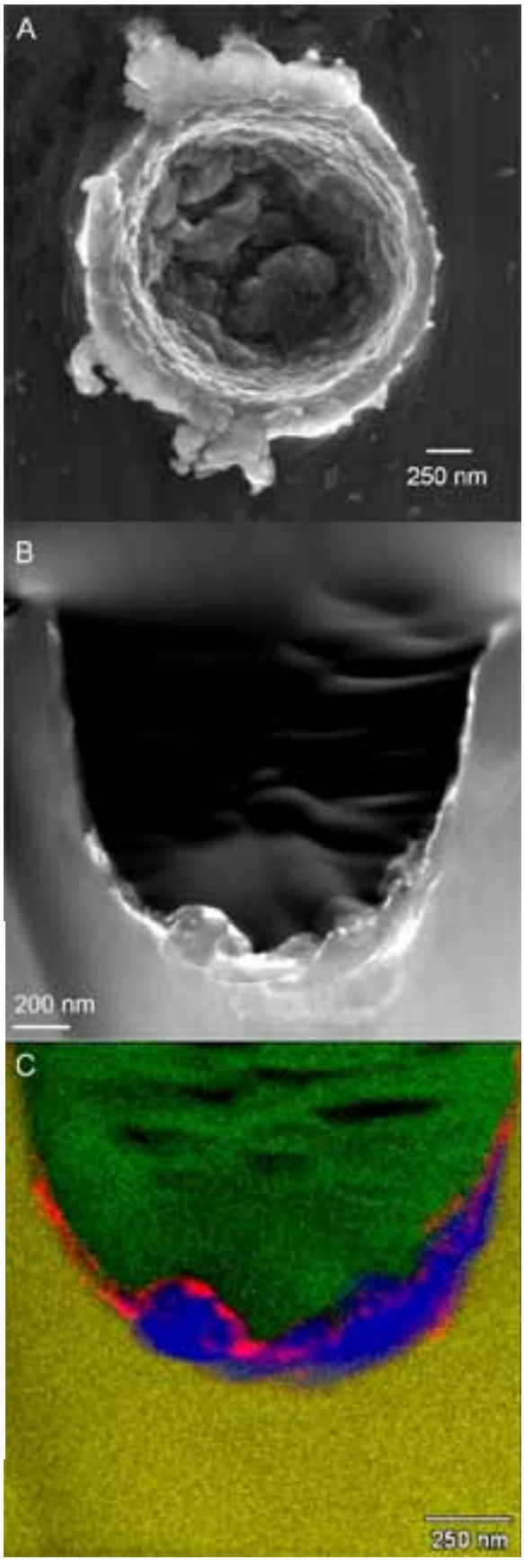


Figure 2

A crater in aluminum foil containing Wild 2 comet material.

B. Scanning transmission electron microscope image of an extracted slice of the crater.

C. a Principal component map identifying the cometary material components: red = iron-nickel sulfide; blue= magnesium-silicate; yellow = aluminum foil capture medium; green = protective carbon coating.

NRL

DTRA presents Chemical and Biological Defense Award to Dr. Anne Kusterbeck, NRL former NRC Associate

Dr. Anne Kusterbeck, Assistant Director of the Center for Bio/Molecular Science and Engineering at the Naval Research Laboratory, **NRC Adviser and former NRC Associate**, is the recipient of the Defense Threat Reduction Agency's (DTRA's) 2007 Chemical and Biological Defense Program International Award. DTRA presents this award to individuals who have made outstanding contributions to furthering collaborative research between the United States and her allies or between an allied nation and the United States. The citation notes that, while detailed to the Office of Naval Research Global (ONRG) in London, Dr. Kusterbeck made ***"significant efforts to maintain, renew, and start relations with a number of international research groups such as the Defence Science and Technology Laboratory. This scientist has played a leading role in all activities toward the Action Group-13 working group, to include briefing the results of the working group to other Technical Cooperation Program (TTCP) groups and senior managers, co-organizing the 2005 International Workshop on Defense Biotechnology in Southhampton, UK, and authoring a formal TTCP Technical Report in 2006."***

In 2003, Anne was asked by the TTCP materials group to organize and chair a DARPA-sponsored workshop to examine the increasing importance of bio-focused research for the Department of Defense and its allies. With Dr. Bhakta Rath, she planned, organized and led the multi-national workshop on Application of Biotechnical Advances to Materials and Sensing Systems. The outcome of that workshop was the formation of an Action Group, G13.

The AG13 panel was tasked to identify research areas of interest to the defense communities and develop collaborative research programs across the member nations. Dr. Kusterbeck was appointed the U.S. Navy representative to the panel that included members from the U.S., the United Kingdom, Australia/New Zealand and Canada. For past 4 years she has worked closely with the AG13 chairman, contributing significantly to the progress of the group towards its objectives. In addition to her TTCP efforts, Dr. Kusterbeck was detailed to ONRG London in the summer of 2005. While there, she assessed defense-related research in biotechnology at the international level to determine areas that were of future utility to the U.S. Navy and advise ONRG on the merits of the work.

In April 2007, Anne co-authored a paper presented at the 1st US-UK Conference on Chem/Bio Detection held in London. This presentation led directly to a request by the British Royal Chemical Society that the group write a book on biotechnology research for defense applications. This book is currently in preparation. In addition, the AG13 is continuing to pursue funding for a collaborative project on autonomous sensors for chemical, biological, radiological/nuclear and explosives detection.

Dr. Kusterbeck has worked with her colleagues for more than 20 years to develop small antibody-based sensors for explosives and drugs of abuse and has more than 80 publications and patents. She has worked extensively with the security and law enforcement community, having completed projects for the Federal Aviation Administration and U.S. Customs. She has also contributed to environmental security as principal investigator on numerous projects to demonstrate and validate portable sensors for on-site testing of soil and groundwater for trace contaminants of the explosives TNT and RDX at U.S. military bases. In response to the attack on the USS Cole, she coordinated the Force Protection: Explosives Detection Experts Workshop held at NRL in August, 2001 that brought together leading researchers in the field to discuss the way forward for detection technologies.

Anne has a B.S. in biology from Virginia's College of William and Mary, conducted postgraduate work in biology at the University of Georgia, and holds an M.S. in management from the University of Maryland. She is the recipient of numerous NRL awards, including an Edison Patent Award, two Technology Transfer Awards, a 75th Anniversary Innovation Award, and several group achievement awards. In 2003, Dr. Kusterbeck received the Applied Science Award from the NRL Edison Chapter of Sigma Xi. In 1992, Ms. Kusterbeck received a technology transfer award from the Federal Laboratory Consortium and the Office of National Drug Control Policy. She serves as the Navy liaison for Biotechnology to The Technical Cooperation Program Materials Group and has co-organized several international workshops on explosives detection and biotechnology for defense applications.

ADVISERS:
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Environmentally Safe Flame-Retardant Polymers for Army Applications

There is a significant need in the Army for improved, cost effective and environmentally safe flame retardant (FR) clothing. Burn injuries are increasing due to urban warfare and can arise from a multitude of flame hazards ranging from incidental exposure, accidents (e.g. battlefield combustibles) and threat-generated exposure (thermal weapons, ballistic, blast, chemical, directed energy). The loss of highly trained military personnel in combat from burn injuries can severely impact the success of military operations. Millions of dollars are spent each year on burn injury treatments for the military and, as noted above, those costs continue to rise each year. Appropriately designed flame protective clothing can provide critical seconds to escape from a flame hazard, reducing exposure time. Current military clothing made from Nomex and Kevlar provides adequate flame protection but the cost to issue these fabrics to every soldier is prohibitive. Lower cost solutions include flame retardant treated cottons/nylons but these FR treatments typically add 20% in weight and use toxic halogenated polymers, many of which are being banned today, worldwide, for environmental and human safety reasons. Melt drip is another undesirable property of these synthetic fabrics where the melt is known to cause additional serious burns.

Dr. Lynne A. Samuelson (Chief Scientist, US Army Natick Soldier Research, Development and Engineering Center (NSRDEC), Natick, MA), with Dr.Ravi Mosurkal (current Sr. NRC Associate)

Dr. Ravi Mosurkal received his PhD from University of Hyderabad, India in 1998. He did his postdoctoral work on organic nonlinear optical materials at the University of Durham, UK, before he joined the Center for Advanced Materials group at University of Massachusetts, Lowell in 2000 to work on dye-sensitized solar cells. Since June 2004, he has been working as an **NRC Senior Research Associate with his NRC adviser**, Dr. Lynne A. Samuelson at the US Army Natick Soldier Research, Development and Engineering Center (NSRDEC), Natick, Massachusetts. In collaboration with University of Massachusetts Lowell, Dr. Mosurkal has been developing a new class of flame retardant (FR) materials that have the potential to meet or exceed the flame protection properties of current FR materials and that have minimal melt drip and are environmentally and human safe.

Through the NRC Research Associateship Program and support from the Environmental Quality Basic Research (EQBR) Program, Dr. Mosurkal has demonstrated the synthesis, characterization and improved thermal and flame retardant properties of novel polysiloxane copolymers and nanocomposites which are expected to have wide use in military and commercial applications. This research, based on the high selectivity of nature's catalysts, enzymes, is environmentally benign and could result in a significant breakthrough in FR materials. This technology is expected to produce fire safe materials, using green chemistry that eliminates both the generation of toxic materials upon combustion and the leaching of toxic chemicals into the environment. These polymers have shown properties similar to or exceeding that of the “gold standard” Nomex and Kevlar materials and offer improved processability for coatings and fibers, are potentially lower in cost and are environmentally friendly.

Laboratory burning test of Army’s camouflage fabric sample

This work was driven by prior knowledge that siloxane-based mixed organic-inorganic polymers, such as non-halogenated polycarbosiloxanes, had very good flame retardant properties. However, these polymers are difficult to synthesize, use environmentally hazardous chemical routes, and high molecular weights are unobtainable. These synthetic hurdles and material limitations were overcome by this NRC sponsored research using a "green chemistry" approach involving a highly selective class of enzymes called lipases. The materials produced by this novel enzymatic “green” synthetic approach offer a new class of materials with FR properties that will be equivalent to the halogen based FR materials but with none of their toxicity and environmental problems. A U.S. patent was issued on this technology in November 2005 and another patent has been filed in September, 2007. Most recently this work has expanded to flame testing on military fabrics. Initial results have been encouraging in that a protective char forms around the fabric and minimizes the melt drip and damage to the fabric. More extensive flame tests will be underway later this year in NSRDEC’s new state-of-the-art Thermal Facility.

Natick

NOAA-NESDIS develop empirical habitat models for nowcasting and forecasting harmful diatom blooms in the Chesapeake Bay

Phytoplankton ecologists are currently interested in the role of harmful algal blooms (HABs) as they relate to human health, anthropogenic change, and biogeochemistry. One factor often implicated in driving the observed global increase in HAB frequency over the last 15 years is cultural eutrophication, or in other words, human-controlled nutrient enrichment to coastal and estuarine ecosystems. In the largest estuary of North America, the Chesapeake Bay, researchers have noted the occurrence of large algal blooms during times of high riverine inputs from the Bay's many tributaries. Perhaps as a result of this terrestrial nutrient enrichment, HABs have become common in the Chesapeake Bay and have threatened the economic viability of the recreational and commercial fisheries in this important region. It is now well known that several species of one microalgal genus, the diatom *Pseudo-nitzschia*, produce the secondary amino acid, domoic acid.

Domoic acid is a potent neurotoxin that bioconcentrates in shellfish and finfish, often resulting in fatal illness for marine mammals, and less frequently, for humans through the consumption of shellfish. Cultures of *Pseudo-nitzschia* spp. taken from a tributary of the Chesapeake Bay have recently been proven capable of significant toxin production, yet to date there have been no reported incidents of amnesic shellfish poisoning in the Bay. However, recent evidence on the West Coast of the dangerous effects of long-term exposure to low-levels of domoic acid suggests we may be underestimating the importance of this diatom group in places like the Chesapeake Bay. The focus of our research is the development of an empirical model that will reliably predict the probability of *Pseudo-nitzchia* spp. bloom occurrence for the Chesapeake Bay using long term datasets of cell abundance and accompanying environmental variables.

A system is already in place in the Chesapeake Bay as part of a NOAA MERHAB project funded in 2005 to predict abundance levels of three key HAB species for the region: *Karlodinium micrum*, *Prorocentrum minimum*, and *Microcystis aeruginosa.* These predictive models incorporate a large suite of environmental and phytoplankton species composition data collected monthly from 14-20 stations in the Chesapeake Bay since 1984 by the Maryland Department of Natural Resources. Using a number of

statistical techniques, Dr. Christopher Brown and colleagues are creating ecological models that can be used to produce nowcasts of HAB species distribution within the Chesapeake Bay.

The same time series used to train their models is now being used by Dr. Clarissa Anderson to model the abundance of *Pseudo-nitzschia* spp. in the Bay. With models that predict the presence and extent of blooms of *Pseudo-nitzschia* in the Chesapeake Bay, we can ultimately address the following questions: (1) Which factors contribute to local bloom initiation? (2) Can we accurately estimate bloom distributions? (3) Can we apply ecological models to the forecasting of *Pseudo-nitzschia* blooms?

Once the ecological model for *Pseudo-nitzschia* has been successfully trained using the *in situ* dataset from 1984-present, it can be applied to the forecasting of *Pseudo-nitzschia* spp. abundance in the Chesapeake Bay. The MERHAB is currently developing and honing two methods for forecasting the necessary environmental variables. Water quality models and satellite data will both be used to estimate near-real time values of hydrographic and chemical parameters. The water quality model that will be most useful for this study is an NPZD model created by Horn Point Laboratory scientists led by Dr. Raleigh Hood.

Among other parameters, this model predicts phytoplankton biomass, primary productivity, respiration, organic/inorganic nutrient and particulate concentrations for the Chesapeake Bay. Measures of sea surface temperature (SST) and chlorophyll can be derived using a 3-dimensional hydrodynamic model developed by the Chesapeake Bay Forecasting group and further validated with near-real time satellite remote sensing imagery acquired through the NOAA CoastWatch Program (http://coastwatch.noaa.gov/). These include daily images of SST from the NOAA Advanced Very High Resolution Radiometer (AVHRR) and the NASA-operated Moderate Resolution Imaging Spectroradiometer (MODIS), and estimates of chlorophyll concentration from the NASA Sea-viewing Wide Field-of-view Sensor (SeaWiFS). All of these parameters are expected to influence *Pseudo-nitzschia* spp. abundance, in particular SST, chlorophyll, nutrient concentrations, and nutrient ratios.

Ultimately, the goal is to produce near real-time estimations of the probability of *Pseudo-nitzshcia* bloom occurrence for the Chesapeake Bay using a combination of hydrodynamic model results and satellite remote sensing data as inputs to the *Pseudo-nitzschia*-specific empirical, habitat model. While we expect the development of empirical models for HABs in the Chesapeake Bay to aid in the management of an important regional problem, these methods can also be applied to global HABs and the model products distributed to international scientists and adapted for large-scale monitoring of deleterious algal blooms worldwide.

Dr. Clarissa Anderson, NRC Associate-NOAA
Dr. Christopher Brown, NOAA-NESDIS

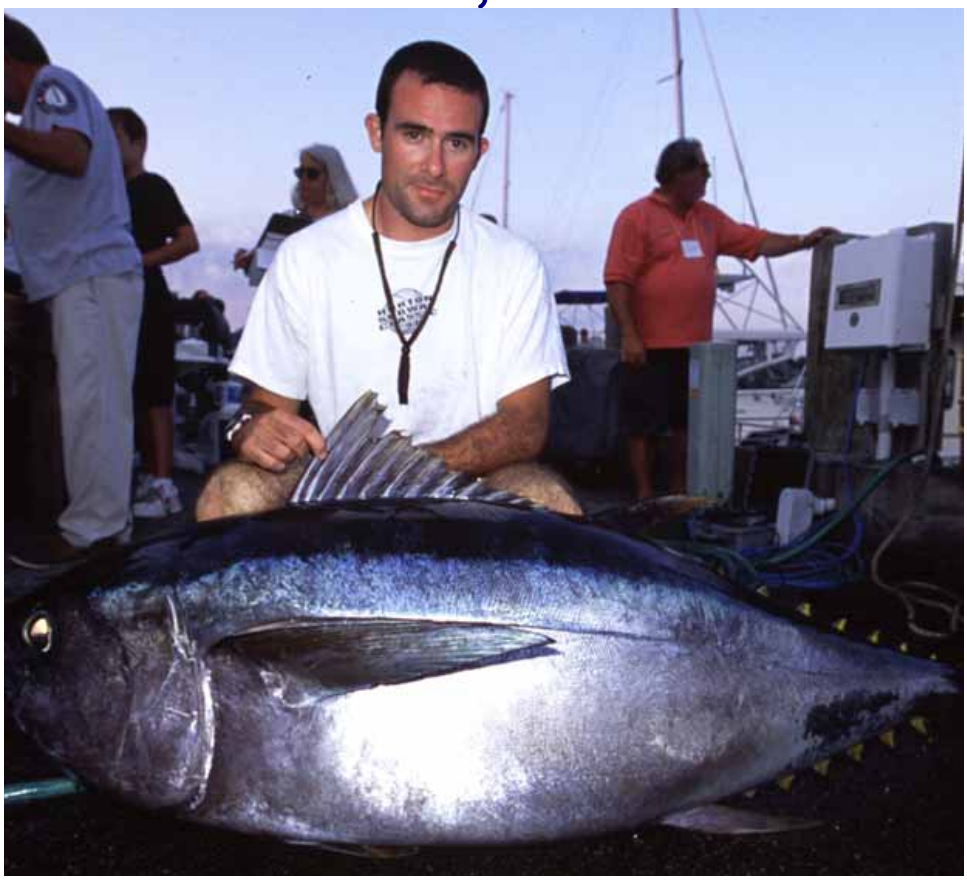
NOAA Profile: Dr. Aaron MacNeil, NRC Associate

Dr. M. Aaron MacNeil has recently joined the Shark Population Assessment Group at the NOAA Fisheries Service Panama City, Florida, Laboratory as an **NRC Associate** investigating the potential ecosystem role of apex predators in the Gulf of Mexico. Aaron completed a Ph.D. in marine biology in August at Newcastle University and arrived shortly thereafter in Panama City to work with Dr. John Carlson, **NRC Adviser,** on developing ecosystem-based approaches to understanding pelagic (offshore) fish community dynamics in the Gulf of Mexico.

The NOAA Fisheries Service-Panama City Laboratory is responsible for assessment of shark populations throughout the US Atlantic and Gulf of Mexico, with particular emphasis on demographic modeling and stock assessment. However, NOAA Fisheries has been pursuing new approaches to ecosystem-based management of marine resources and, over the past few years, the Panama City Laboratory has been developing its own ecosystem-based modeling capacity.

Within the fisheries community there is substantial debate about the fate of large pelagic fishes in many of the world's oceans, with some researchers claiming that stocks have almost entirely collapsed and others claiming that stocks are at or near maximum sustainable yield. Most fisheries scientists agree however that many of these stocks are at historic lows in abundance and there is considerable interest in understanding the ecosystem consequences of abundance changes in large pelagic fishes.

Aaron's Ph.D. work into developing models of fish functional group dynamics on coral reefs and several years prior experience working with sharks made Aaron's role in the Panama City group particularly timely. His interest in mrine environment began while growing up in Nova Scotia, where he developed a fascination with sharks, whales, and fish. While attending Dalhousie University to pursue a degree in Marine Biology, Aaron learned about the plight of Newfoundland cod stocks, which collapsed in the early 1990's and have never recovered, cementing a desire to help conserve fisheries for future generations. The research at Panama City Laboratory should provide just such an opportunity, where the research outcomes will promote a greater understanding of the ecosystem effects of human disturbance.



With a focus on the sharks, tunas, and billfish that compose the top of the Gulf of Mexico's food chain (the apex predators), as well as their prey (the mesopredators), Aaron's research is attempting to identify concurrent patterns in predator and prey abundance that may be due to the effects of fishing or environmental factors. In general, the feeding chain at the top of pelagic food webs are relatively linear, with the largest fishes consuming the largest or most abundant prey they can find and, in turn, with their prey consuming the largest prey they can consume. Defining the size-based structure of pelagic food webs was the first step in identifying the functional role of fish species within the Gulf of Mexico pelagic ecosystem.

Often however, catches in commercial trawls or on longline gear are a mixture of coastal, benthic (bottom), mesopelagic (deep water) and pelagic species. A critical part of MacNeil's work, in collaboration with Dr. Aaron Fisk at the University of Windsor, is using ecological tracers (stable isotopes) to assign individual fish species to a specific marine community. Once these communities have been defined, the research will explore trends within communities that compose the isotope-defined boundaries and functional group assignments for the study region.

The bulk of Dr. MacNeil's research will use statistical models to quantify trends in pelagic fish functional groups and explicitly link them to trends in fishing and climate that have occurred throughout the Gulf of Mexico. While it is intuitive that sharks and tunas play an important role in pelagic ecosystems, relatively little research has specifically addressed the issue. In part this is due to the logistical difficulties of working at sea and the impossibility of conducting experiments at such a large scale. Drs. MacNeil and Carlson hope to overcome these difficulties by combining NOAA's extensive fisheries databases into a modeling framework that captures the prominent changes in fishing and fish functional groups, while relying on hierarchically-structured statistical models to handle the exceptionally high level of complexity in the Gulf of Mexico's marine fish community.

NOAA

NRL former NRC Associate, Dr. Michael Hadjimichael, receives SAE International's Arch T. Colwell Merit Award

Dr. Michael Hadjimichael, a computer scientist with the Naval Research Laboratory, received SAE International's Arch T. Colwell Merit Award. Michael and co-author, Dr. John McCarthy were recognized for their paper, "Development of a Fuzzy Expert System for Aviation Risk Modeling.", and presented the award during the SAE Aero-Tech Congress & Exhibition in Los Angeles in September, 2007.

The Flight Operations Risk Assessment System (FORAS) described in Drs. Hadjimichael and McCarthy's paper is a risk modeling methodology that represents risk factors and their interrelationships as a fuzzy expert system. FORAS systematizes the process of eliciting human expertise, provides for a natural representation of the knowledge in an expert system, and automates the process of risk assessment.

There are many challenges in developing such a system. These include the selection of relevant subject matter experts; the combination and reconciliation of multiple, subjective knowledge bases; and the representation of knowledge in a model easily expressed, evaluated, and revised. Their paper presents the technical background of the FORAS methodology, and demonstrates its implementation, as performed on its first operational partner, EVA Airways, of Taiwan. Other airlines are also planning to use FORAS methods in the near future.

The risk model implementation and deployment in an operational context allows safety personnel to track and analyze past risk exposure on an individual flight basis, as well as per route, month, and airport. This analysis will allow the airline to focus on high-exposure areas and take appropriate action to mitigate risk. Analysis of future flights can also determine mitigative action, as well as indicate situations where heightened alertness is required.

The Arch T. Colwell Merit Award, established in 1965, annually recognizes the authors of outstanding papers presented at an SAE or SAE section meeting. Papers are judged primarily for their value as new contributions to existing knowledge of mobility engineering. The late Arch T. Colwell, who first funded this award, served SAE International in many capacities for nearly 50 years, including a term as President in 1941. The SAE Foundation now funds this award. In addition to supporting the awards, recognition and scholarship programs of SAE International, the SAE Foundation develops and funds programs and incentives that foster student interest in engineering, scientific and technical education.

Michael received his B.A. in computer science and physics from Cornell University, Ithaca, NY; his M.Sc. in computer science from State University of New York at Stony Brook; and his Ph.D. in computer science from the University of Regina, Saskatchewan, Canada. He works in NRL's Marine Meteorology Division where his areas of research and interest include artificial intelligence, fuzzy systems, risk modeling and data mining. He has been involved in aviation risk assessment for seven years, and his research has concentrated on the use of fuzzy and Bayesian systems to model aviation risk. Other current research involves the use of knowledge discovery methods to estimate weather parameters from numerical weather models and satellite data.

Dr. Hadjimichael received an NRC Research Associateship Award from 1995 to 1998. Dr. McCarthy, the co-author on the paper, is President of Aviation Weather Associates, Inc., in Palm Desert, CA. He is also a weather consultant with the Federal Aviation Administration. Previously, he worked at NRL in Monterey, CA, and served as Director of the Research Applications Laboratory at the National Center for Atmospheric Research in Boulder, CO.

NRL

NRC Staff Profile

Alex Cohen
Senior Program Associate

Alex Cohen was a Senior Program Associate with The National Academies (NA), performing project management, analysis, and research. Beginning employment with the National Academies in 1999, he is thought to be the only NA employee to work in all of its three national locations — Woods Hole MA, Irvine CA, and Washington DC.

With a B.S. in computer science and a minor in mathematics, Alex is currently a graduate student enrolled in a Masters of Public Policy program. He left the academies in March for a new position at the Federation of American Scientists as a Learning Technology Program Manager.

Congratulations, Alex!
Thank you, we'll miss you, and best wishes.

Dr. Richard J. Colton, Director of the Institute of Nanoscience, Acting Superintendent of the Chemistry Division at the Naval Research Laboratory, and NRC Adviser, won the 2007 Albert Nerken Award from the American Vacuum Society (AVS). The award was presented at the AVS Symposium in Seattle, Washington, on October 17, 2007.

The Nerken award is given by AVS to recognize outstanding contributions to the solutions of technological problems in areas of interest to AVS. It was established in 1984 by Veeco Instruments, Inc., in recognition of its founder, Albert Nerken, for his role as a founding member of AVS, his early work in the field of high vacuum and leak detection, and his contributions to the commercial development of that instrumentation.

Dr. Colton is specifically cited "for seminal scientific insights that accelerated the development of vastly improved surface and nanoscale analytical techniques, and of innovative biomolecular sensors." Dr. Colton's research interests include electron and ion spectroscopies, atomic and molecular structure of surfaces by scanning tunneling microscopy, new methods to measure nanoscale adhesion, friction and mechanical properties of surfaces by atomic force microscopy, and novel physical, chemical and biological sensors using electron tunneling and molecular recognition.

As a scientist, in the late 1970s, Dr. Colton first introduced to the Laboratory the surface analysis technique of secondary ion mass spectrometry. In 1986, while on sabbatical as a Visiting Associate at the California Institute of Technology in Pasadena, California, he built a scanning tunneling microscope (STM) and used it to understand the then mysterious, atomically-resolved, imaging mechanism of graphite in air. He is credited with bringing the STM technique back to NRL, which has since served as the catalyst for the present nanoscience effort at NRL.

AVS presents Albert Nerken Award to former NRC Associate, Dr. Richard Colton, NRL Scientist and NRC Adviser

Dr. Colton also introduced the atomic force microscope (AFM) to the Laboratory at the time it was developed. He recognized that the AFM was more than an imaging tool and could be adapted to perform nanomechanics on surfaces and molecules. The AFM formed the basis of an important approach to the detection of bio-threat agents, funded by DARPA, NIH, and the Army.

Rich earned a B.S. in chemistry and a Ph.D. in physical chemistry from the University of Pittsburgh in 1972 and 1976, respectively. In 1976, he became a **NRC Associate** at NRL. He joined the NRL Chemistry Division in 1977 as a research chemist working in surface chemistry. He has since served as head of the Advanced Surface Spectroscopy Section in the Surface Chemistry Branch, head of the Surface Chemistry Branch, and is now serving concurrently as head of the Chemistry Division and Director of the Institute for Nanoscience.

Dr. Colton has published over 130 technical papers, including ten book chapters and five patents, which have been cited in the literature over 6,000 times. He is a member of the American Chemical Society, Sigma Xi, the American Physical Society, the Materials Research Society and AVS. He was the first chairman of the AVS Division on Nanometer-scale Science and Technology, former chair of the AVS Applied Surface Science Division, and served on the AVS Board of Directors in 1992-93. He was elected a Fellow of the AVS in 1995. He received the 1992 Hillebrand Prize from the Chemical Society of Washington, received the NRL-Edison Chapter of Sigma Xi Applied Research Award in 1999, and has won numerous technical publication and technology transfer awards including the Federal Laboratory Consortium Award for Excellence in Technology Transfer in 2001. Dr. Colton also received the Navy Meritorious Civilian Service Award in 2003.

NOAA Profile: Dr. Leon Kocharov
Space Weather Prediction Center

NOAA's Space Weather Prediction Center (SWPC), Boulder, Colorado, continually monitors and forecasts Earth's space environment; and provides accurate, reliable, and useful solar-terrestrial information and forecasts to customers affected by Space Weather. The Center also conducts and leads research and development programs to understand the space environment to improve services. As part of this research, Dr. Leon Kocharov, NRC Senior Research Associate, joined SWPC in October 2007 to work on models that will better predict the arrival of solar energetic particles, interplanetary magnetic clouds and shock waves at Earth.

These models are essential to protect humans, as well as new technologies in space and on the ground that, as they become more sophisticated, are also becoming more sensitive and vulnerable to space weather effects. In addition, in the not too distant future, astronauts will be making long-duration expeditions to the Moon and Mars. As a consequence, the international space community has a goal to produce physics-based models of the interplanetary and near-Earth space environment that can provide the accurate predictions needed to protect space devices and personnel from space weather storms. Achieving this ambitious goal requires expertise with numerical algorithms, an understanding of solar and interplanetary physics, and observations.

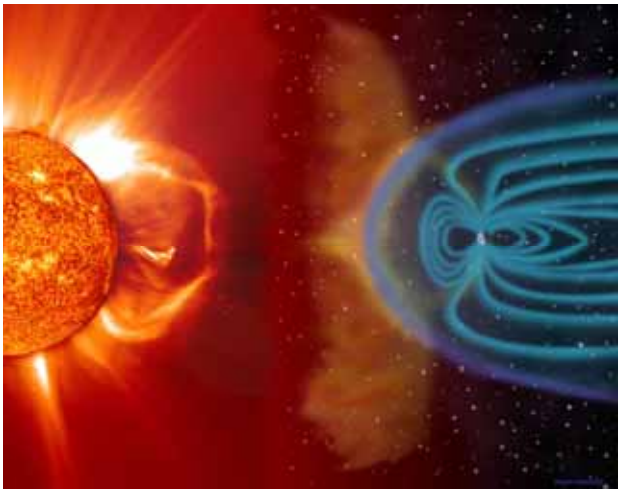


Figure 1: The Space Weather Chain from Sun to Earth.

***Left*: a composite of solar observations showing the Sun and a Coronal Mass Ejection (CME).**

***Right*: a sketch of Earth's space environment and its magnetic shield. Earth's environment is affected by the solar wind, CMEs, magnetic clouds, and shock waves; and by the solar energetic particles that are produced in solar eruptions and CMEs as they are initiated and as they propagate towards Earth.**

In summary, the focus of Dr. Kocharov's research is to understand how high-energy particles are accelerated in solar flares and coronal mass ejections (CME's), how they propagate in coronal and interplanetary magnetic structures, and how they are involved in different atomic and nuclear interactions. His approach involves both data analysis and theoretical modeling. As part of his NRC Senior Associateship, Dr. Leon Kocharov, in collaboration with his NOAA colleagues Dr. Vic Pizzo and Dr. Dusan Odstrcil, is developing new methods for diagnostics of coronal mass ejections, from their initiation at the Sun to their interaction with the Earth's magnetosphere.

Dr. Leon Kocharov has a background in space plasma physics. He received his Ph.D. in plasma physics in 1981 from Moscow State University and has worked in Russia at St. Petersburg Polytechnic University, in the U.S. at the California Institute of Technology, and in Finland at the University of Turku.

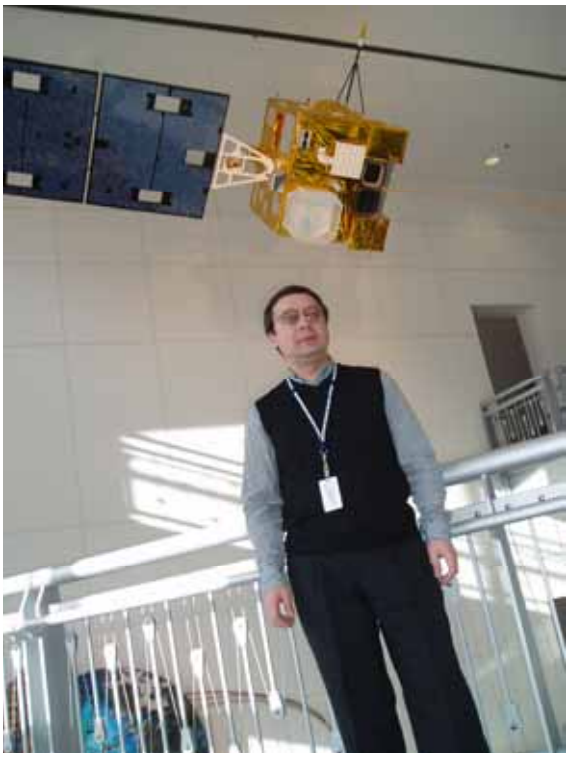


Figure 2:

Dr. Leon Kocharov, NRC Senior Associate at NOAA's Space Weather Prediction Center, in Boulder, Colorado. Leon Kocharov standing below a model of one of NOAA's Geosynchronous Operational Environmental Satellites (GOES 8-12 series). In addition to meteorological observations, GOES makes space weather observations. These include observations of solar sources of space weather using a Solar X-ray imager, a solar whole disk X-ray sensor, and solar energetic particle sensors.

EPA Contamination Scene Investigation (CSI) tracking down the sources of fecal pollution using molecular probes

Water sources are commonly polluted by fecal bacteria primarily from non-point sources such as wildlife, domesticated animals, and agricultural and urban runoff. Among them, animal fecal pollution is unambiguously the major source of pollution in the U.S., as evidenced by increasing number of outbreaks of zoonotic pathogens. It was recently estimated that annual feces production in the U.S. is approximately 1×10^9 tons. Poultry are responsible for 44% of the total feces production in the U.S., followed by cattle (31%) and swine (24%).

Detecting and ranking the sources of fecal pollution is a challenging task that often requires intensive monitoring of various potential nonpoint sources. As a consequence of the development and implementation of total maximum daily loads (TMDL), methodologies have been developed to determine the sources of fecal contamination in waters. The utilization of this approach in the environment is commonly referred to as microbial source tracking (MST). NRC research associate Dr. Yong Jin Lee and his advisor Dr. Marirosa Molina at the U.S. EPA have been working in MST using culture-independent host-specific PCR assays that are gaining wide acceptance because of their potential for high-throughput and quick turn-around times.

Over the last 24 months, Drs. Lee and Molina have been collecting water and sediment samples from diverse local streams associated with cattle and chicken farms. Samples were processed to determine traditional fecal indicator (enterococci) density and the occurrence of source-specific fecal indicators. While most MST studies employ one assay-one genetic marker (OAOGM) approach to detect the source of fecal contamination, they have used multiple assays combining newly developed metagenome-based markers with 16S rRNA gene-based markers.

In a watershed impacted directly by cattle fecal pollution, the 16S rRNA gene-based ruminant-specific marker was detected in 65% of the samples, while metagenome-based cattle-specific markers, developed from DNA extracted directly from fecal material were found in 32-37% of the samples. In contrast, both types of markers were detected in less than 6% of the samples in a watershed affected only by run-off. They also performed statistical analyses such as binary logistic regressions and multiple linear regressions, and identified that pH, temperature and enterococcal density were positively correlated with the occurrence of source-specific markers.

Moreover, the correlation between the occurrence of the molecular markers and specific environmental parameters depended on the management technique implemented at the farm associated with the stream of interest.

They are now focusing on tracking multiple sources of fecal contamination such as cattle, human and chicken and evaluating transport of chicken fecal material from manure-fertilized pastures into adjacent streams. For this project, they are applying recently developed chicken- and bird-specific metagenome-based markers to water samples collected from streams impacted by various levels of composted chicken manure. The results so far indicate that general *Bacteroidales*-like signatures are detected in almost all streams (96.2%) while ruminant-specific *Bacteroidales*-like signatures are detected with less frequency (0-82.1%). They are applying chicken- and bird-specific markers to the same samples.

This study has identified significant environmental factors influencing the spatiotemporal variability of source-specific markers and enterococcal density. It has also documented the effect that different management techniques may have on the fate of source-specific markers, and established a positive correlation between a traditional fecal indicator and the occurrence of alternative molecular fecal indicators. In addition, the study revealed that using multiple molecular assays for sourcing fecal pollution can provide more solid results in MST studies. They expect that these studies provide fundamental insights into understanding the relationships among MST assays, fecal indicator numbers and environmental predictors and help provide more accurate and reliable risk assessment for prevention or mitigation of fecal pollution in waters.

NRC Associate, Dr. Yong Jin Lee,
US EPA/National Exposure Research Laboratory
Ecosystems Research Division
Athens, Georgia

After Kidd and her colleagues with Fisheries and Oceans Canada added estrogen to the lake in 2001, male fish in this lake started producing eggs or egg proteins and female fish produced up to 115 times more estrogen than normal. During the next summer, the fathead minnow, the shortest-lived fish species in the lake, stopped reproducing until more than 99 percent of its population was lost. This has impacts all through the food chain, ultimately hitting top predators and the entire lake ecosystem. In the next two years, she saw depletions in longer-lived species: the pearl dace declined 86 percent and trout, 30 percent.

But Kidd also has some good news: "Once you take the estrogen out of the system, given enough time, the fish return to their original abundance." By 2006, three years after the scientists ceased adding estrogen to the water, the fathead minnow began to repopulate the lake. This suggests that if treatment plants could remove such chemicals from municipal wastewaters before they enter the environment, affected ecosystems could rebound.

Dilution Not the Solution

Steven Bay at the Southern California Coastal Water Research Project in Costa Mesa, Calif., has seen evidence of altered hormone levels in marine fish. The hornyhead turbot, a common flatfish in the coastal waters of Southern California, hangs out on the seafloor where it can be exposed to a chemical cocktail discharged from nearby wastewater pipes. These chemicals range from industrial compounds to pharmaceuticals, some of which could contain substances that interfere with the fish's hormone system.

Bay found that up to 90 percent of the male hornyhead turbot tested at some locations had produced egg yolk proteins. They also had estrogen levels as high as females and low thyroid hormone and cortisol levels. Thyroid hormone manages growth, so development of the fish embryos could be impaired. And as cortisol is produced in response to stress, the low levels could actually mean the fish might be overstressed and "worn out," leaving them vulnerable to disease. Most of these responses in the fish were widespread and not confined to the areas around the discharge pipes, so their precise cause and source remain a mystery.

While you might think that the vast ocean could dissipate these chemicals, Bay says dilution is not the solution: "More than a billion gallons of treated municipal wastewater are discharged into Southern California coastal waters every day. Our study shows that some of these contaminants can be detected in sediments and water, even though the effluent is immediately diluted at least one hundredfold upon discharge."

Because most municipal treatment plants do not completely remove chemicals from wastewater, this study could have implications for groundwater and surface water. Treated wastewater effluent is sometimes discharged into rivers and used to replenish groundwater or to irrigate landscapes. If these chemicals are not filtered out through natural processes, they could end up in our drinking water supplies.

Carolyn Sotka, a contractor who is a senior science policy analyst at NOAA's Oceans and Human Health Initiative, says, "It's ironic that although we use drugs and products to benefit our health and well-being, we can sometimes in turn hurt our environment and ourselves. Studies such as these force us to see the whole picture, to make the connection not only between land and sea, but also how what we put in or on our bodies or use in our homes can affect our world." Sotka says a better understanding of the impacts of emerging contaminants will lead to improved management decisions for the environment, especially coastal ecosystems that are already battling such a multitude of stresses.

John Incardona, NOAA Northwest Fisheries, Science Center, John.Incardona@noaa.gov

Jennifer Keller, National Institute of Standards and Technology, Hollings Marine Laboratory, Jennifer.Keller@noaa.gov

Nathaniel L. Scholz, NOAA Northwest Fisheries Science Center, Nathaniel.Scholz@noaa.gov

Former NRC Associate, Dr. John Incardona, now works with the ecotoxicology program at the Northwest Fisheries Science Center in Seattle, Washington.

Dr. Incardona captured international media attention in February after revealing how toxic chemicals we use everyday are ending up in our rivers and oceans, where they affect fish and possibly ourselves.

At the annual AAAS conference in 2008, John showed how petroleum compounds (i.e., PAHs) are toxic to developing fish hearts, and how airborne emissions of these chemicals from car tailpipes may have similar cardiovascular impacts in humans.

NRC Staff Profile

Charlie Fink
Senior Analyst

Charlie Fink joined the National Academies of Science in the spring of 2007. He works in the PGA-Fellowships office designing, developing, and supporting IT systems. He has been designing and developing leading software solutions for over 15 years. He has successfully managed a large number of software projects, including enterprise development, complex data migrations, and decision support systems (DSS). As a project manager, Charlie has also developed and lead client training focused on use and support of custom software systems.

Welcome, Charlie!

2006 NRC/ASEE Postdoctoral Research Publication Awards

Honored March 9, 2007

Aptamer-Based Detection and Quantitative Analysis of Ricin Using Affinity Probe Capillary Electrophoresis
Amanda J. Haes, Braden C. Giordano, and Greg E. Collins

Electrically Tunable g Factors in Quantum Dot Molecular Spin States
M. F. Doty, M. Scheibner, I. V. Ponomarev, E. A. Stinaff, A. S. Bracker, V. L. Korenev, T. L. Reinecke, and D. Gammon

Role of Defects in Single-Walled Carbon Nanotube Chemical Sensors
Joshua A. Robinson, Eric S. Snow, Stefan C. Badescu, Thomas L. Reinecke, and F. Keith Perkins

Optical Signatures of Coupled Quantum Dots
E. A. Stinaff, M. Scheibner, A. S. Bracker, I. V. Ponomarev, V. L. Korenev, M. E. Ware, M. F. Doty, T. L. Reinecke, and D. Gammon

Prevention of Nonspecific Bacterial Cell Adhesion in Immunoassays by Use of Cranberry Juice
Brandy Johnson-White, Lauren Buquo, Mazyar Zeinali and Frances S. Ligler

Captain Gahagen Presents NRC/ASEE Postdoctoral Publications


Dr. Amanda Haes


Dr. Braden Giordano


Dr. Matthew Doty


Dr. Joshua Robinson


Dr. Eric Stinaff


Dr. Brandy Johnson-White

2007 NRC/ASEE Postdoctoral Research Publication Awards

Honored March 28, 2008

NRC Associates: Nadia Kulagina, Michael Martin, Cara Rakowski, Sophia Economou
NRC Advisers: Brian Houston, Chris Taitt, Fran Ligler, Tom Reinecke

NPS

Orientation Imaging Microscopy of Deformed Materials

The Colors of Materials Science

Srinivasan Swaminathan and Jianqing Su are working as NRC Research Associates under the guidance of Terry R. McNelley, a Distinguished Professor of Materials Science in the Department of Mechanical and Astronautical Engineering at the Naval Postgraduate School in Monterey, CA. Dr. Swaminathan holds Ph.D. and M.S. degrees from the School of Industrial Engineering at Purdue University, West Lafayette, IN and a undergraduate B.Tech. degree from the Department of Metallurgical Engineering and Materials Science at Indian Institute of Technology (IIT), Bombay, India. Dr. Su holds Ph.D. and M.S. degrees in Materials Science and Engineering from the Institute of Metal Research, Chinese Academy of Sciences.

Over the past decade a novel technique called Orientation Imaging Microscopy (OIM) has emerged as a method to characterize the microstructure, microtexture and grain boundary misorientation distributions using electron backscattered diffraction (EBSD) analysis in scanning electron microscopy (SEM). Of special interest is that OIM can provide information from a meso-scale level regarding the characteristics of a region of interest. In our laboratory, we routinely use OIM to characterize the microstructure and microtextural features of severely deformed microstructures.

Figure 1 shows an illustration of OIM applied to copper subjected to large strain deformation by the process of chip formation in plane-strain machining (a process developed during the Ph.D. dissertation of Dr. Swaminathan at Purdue University). The ease of obtaining meso-scale information across the different faces of the material is shown by means of tri-planar images that show uniform deformation occurring across the entire volume of the material during chip formation.

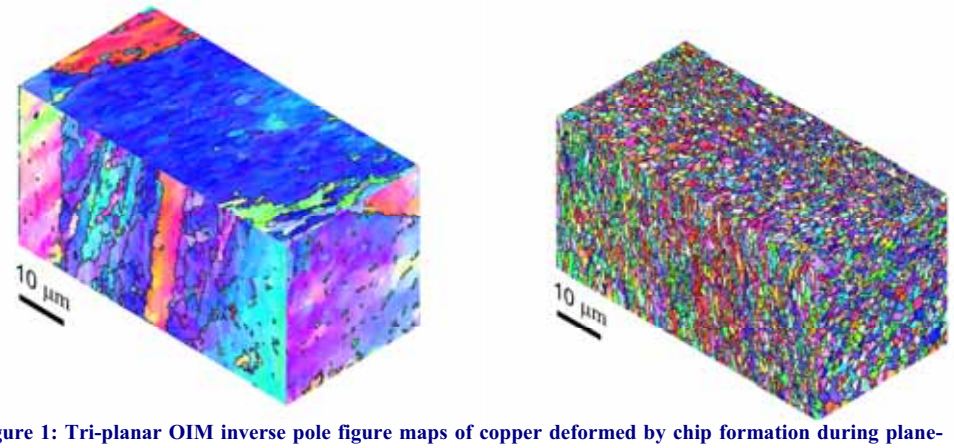


Figure 1: Tri-planar OIM inverse pole figure maps of copper deformed by chip formation during plane-strain machining to strains of (a) 3 and (b) 11. The microstructure refinement results in the formation of elongated dislocation structures, cells and dislocation tangles at lower strains that finally transform to equiaxed dislocation structures as the strain level increases. The different shades of blue on the top surface in (a) indicates the presence of low-angled (<15° misorientation) dislocation structures.

In addition to studying severe deformation characteristics, OIM analysis also proves useful in microstructural characterization of materials subjected to conventional thermomechanical processes.

Figure 2 (opposite page) shows microstructure and microtexture along the RD-ND plane (rolling direction-normal direction) of an aluminum alloy (AA5083) subjected to hot rolling to 74% reduction at 300°C. The figure shows that, while the bulk of the material experiences plane-strain deformation by rolling, the material in close contact with the rolls undergoes additional shear deformation.

When OIM analysis is applied to Friction Stir Processing (FSP), a novel process that involves steep gradients in strain, strain rate and temperatures, interesting observations are made on the operative recrystallization mechanisms.

Figure 3 (opposite page) compares two different alloys subjected to friction stir processing. An aluminum alloy (AA2099) subjected to FSP shows the presence of large grains that possess shear deformation textures (Fig. 3a). In fact, by selective highlighting one can discern that high-angled (>15° misorientation) boundaries are interfaces between texture variants. These observations suggest that, during FSP, AA2099 undergoes microstructure refinement by the process of geometric dynamic recrystallization (GDRX). In contrast, AA5083 subjected to near similar processing conditions forms ultra-fine grains in the order of ~1 m and having random texture, suggesting the operative microstructure refinement mechanism to be consistent with that of particle stimulated nucleation (PSN).

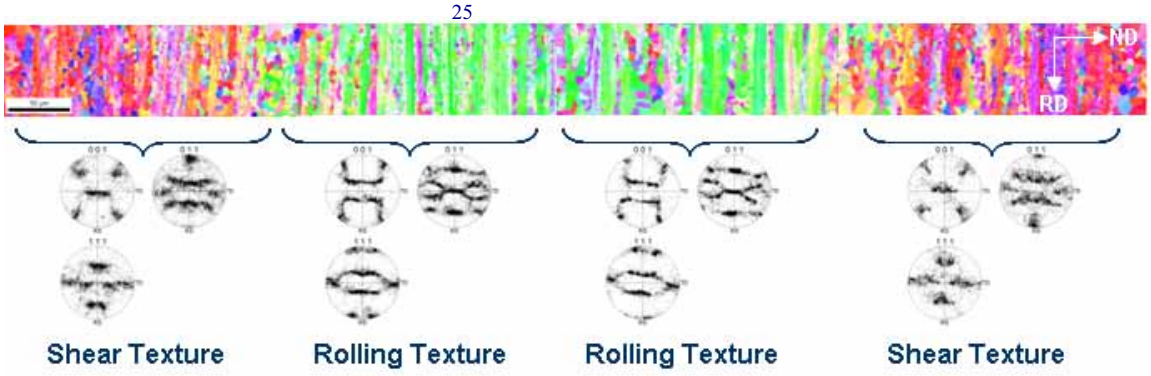
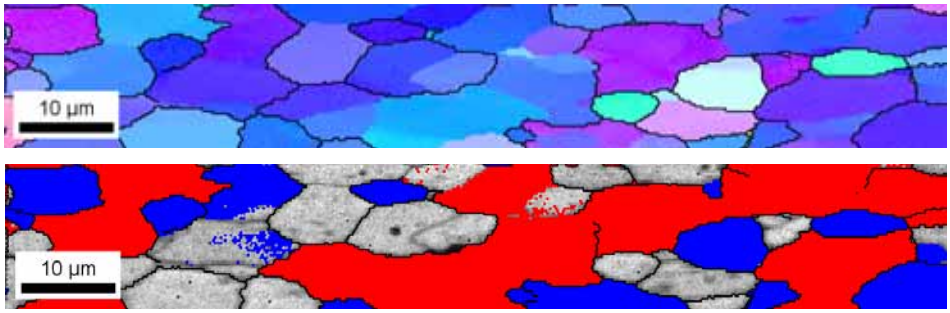
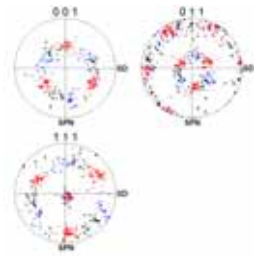


Figure 2: Montage of OIM inverse pole figure maps along with respective microtextural information showing the presence of shear textures close to the surface in contact with the rolls while the mid-plane is made up of characteristic rolling textures.



(a)

(b)



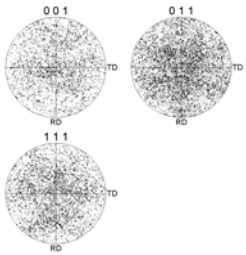
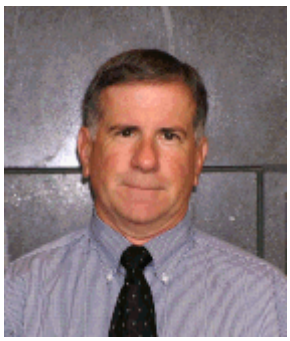


Figure 3: (a) Inverse pole figure map, highlighted image quality map and highlighted pole figure from the transverse orientation of AA2099 subjected to FSP. (b) Inverse pole figure map and corresponding pole figure from transverse orientation of AA5083 subjected to FSP.

In summary, OIM analysis is a useful characterization tool for understanding the development of microstructures and other attributes during large strain deformation of materials. The tool serves to bridge observations made on the macroscopic level using optical microscopy and X-ray diffraction on one end and microscopic level using transmission electron microscopy on the other.

NRC Staff Profile



H. Ray Gamble, Ph.D.,
Director
Fellowships Office
Research Associateship Programs

Dr. Gamble received his B.A. from Lafayette College and an M.S. and Ph.D. from the Ohio State University and was an NIH Postdoctoral Fellow at the University of Massachusetts. His began his professional career as a Research Scientist with the USDA's Agricultural Research Service in 1981 and remained there until 2000. From 1993-2000 he was Laboratory Director of the Parasite Biology and Epidemiology Laboratory located in Beltsville, Maryland, managing research programs in animal disease, public health and food safety. He has over 170 publications in the fields of food safety/zoonotic diseases, parasitic diseases of livestock, disease detection, and vaccine development. Dr. Gamble assumed his present position with the National Research Council in 2000. He remains active in research through collaborative grants with the USDA and university colleagues and serves as an Adjunct Professor in the George Washington School of Medicine.

PROGRAM PROMOTION 2008

Associateship Programs Staff members will be available at an Exhibit Booth.

American Institute for Aeronautics & Astronautics	Jan 7 to Jan 10	Reno, NV
American Meteorological Society (#734)	Jan 20 to Jan 24	New Orleans, LA
Society of Photo-Optical Instrumentation Engineers	Jan 22 to Jan 24	San Jose, CA
Biophysical Society (#427)	Feb 2 to Feb 6	Long Beach, CA
Johns Hopkins Univ/Science & Technology Career Fair	Feb 12	Baltimore, MD
National Society of Black Physicists	Feb 20 to Feb 23	Washington, DC
American Physical Society	Mar 10 to Mar 14	New Orleans, LA
Nat'l Org Professional Adv of Black Chemists & Chem Eng	Mar 16 to Mar 21	Philadelphia, PA
National Society of Black Engineers (#1624)	Mar 20 to Mar 22	Orlando, FL
Experimental Biology	April 4 to April 9	San Diego, CA
American Chemical Society	April 7 to April 9	New Orleans, LA
American Society for Microbiology	June 1 to June 5	Boston, MA
Ecological Society of America	Aug 3 to Aug 8	Milwaukee, WI
American Fisheries Society	Aug 17 to Aug 21	Ottawa, Ontario
American Chemical Society	Aug 18 to Aug 20	Philadelphia, PA
Human Factors and Ergonomics Society	Sept 22 to Sept 26	New York, NY
Geological Society of America	Oct 5 to Oct 8	Houston, TX
SEA Student Technical Conference	Oct 8 to Oct 11	Gaithersburg, MD
Soc for Adv of Chicanos & Native Americans in Science	Oct 9 to Oct 12	Salt Lake City, UT
Hispanic Association of Colleges and Universities	Oct 11 to Oct 13	Denver, CO
Mexican American Engrs & Scientists Symp & Career Fair	Oct 23 to Oct 25	Las Vegas, NV
Florida Education Fund/McKnight Fellows Meeting	TBD	TBD
American Public Health Association	Oct 25 to Oct 29	San Diego, CA
American Indian Science and Engineering Society	Oct 30 to Nov 3	Anaheim, CA
Annual Biomedical Res Conference for Minority Students	Nov 5 to Nov 8	Orlando, FL
Society for Neuroscience	Nov 15 to Nov 19	Washington, DC
Materials Research Society*	Dec 1 to Dec 5	Boston, MA
American Society of Tropical Medicine and Hygiene	Dec 7 to Dec 11	New Orleans. LA
American Society for Cell Biology	Dec 13 to Dec 17	San Francisco, CA
American Geophysical Union	Dec 15 to Dec 19	San Francisco, CA

*Job placement only - no exhibit booth.

2008 PARTICIPATING PROGRAMS

Air Force Research Laboratory (AFRL) - 261

Armed Forces Radiobiology Research Institute (AFRRI) - 11

Center for Devices and Radiological Health (CDRH) - 20

Chemical and Biological Defense (CBD) - 0

FAA/Civil Aerospace Medical Institute (CAMI) - 11

Federal Highway Administration/Turner-Fairbank Highway Research Center (FHWA) - 6

Institute for Water Resources (IWR) - 10

National Energy Technology Laboratory (NETL) - 27

National Energy Technology Laboratory Methane Hydrates Fellowship Program (NETL/MHFP) - 1

National Institute for Occupational Safety and Health (NIOSH) - 56

National Institute for Occupational Safety and Health Master's Level Program (NIOSH/MLP) - 56

National Institute for Occupational Safety and Health Summer Faculty Fellowship Program (NIOSH/SFFP) - 56

National Institute of Standards and Technology (NIST) - 778

National Institutes of Health (NIH) - 256

National Institutes of Health (NIH)/National Institute of Standards and Technology (NIH/NIST) - 66

National Oceanic and Atmospheric Administration (NOAA) - 291

Naval Medical Research Center/Naval Health Research Center (NMRC/NHRC) - 37

Naval Postgraduate School (NPS) - 35

Naval Research Laboratory (NRL) - 486

Navy Marine Mammal Program (MMP) - 4

Pacific Disaster Center (PDC) - 10

US Army Aviation and Missile Command (AMCOM) - 12

US Army Edgewood Chemical Biological Center (ECBC) - 54

US Army Medical Research and Materiel Command (AMRMC) - 146

US Army Natick Soldier Research, Development and Engineering Center-US Army Research, Development and Engineering Command (NSRDEC) - 20

US Army Research Laboratory (ARL) - 125

US Army Research Office (ARO) - 18

US Army Research, Development & Engineering Command, Night Visiion & Electronic Sensors Directorate (NVESD) - 17

US Army Research, Development, and Engineering Command/Armament Research Development and Engineering Center (RDECOM/ARDEC) - 6

US Environmental Protection Agency (EPA) - 122

US Environmental Protection Agency Summer Faculty Fellowship Program (EPA/SFFP) - 122

US Geological Survey (USGS) - 106

US Marine Mammal Commission (MMC) - 3

US Military Academy/US Army Research Laboratory (USMA/ARL) - 125

2008 PARTICIPATING PROGRAMS

2008 SCHEDULE

February Review

Submission deadline - February 1
Transcripts and Reference Reports deadline - February 15.
The Board meets on March 21.
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 26.
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 27.
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 9, 2009.
Agencies will be notified within two weeks.

WRAIR NRC Associate, Dr. Tracy Rupp, wins National Sleep Foundation Young Investigator Award

Dr. Tracy Rupp has won the National Sleep Foundation Young Investigator Award. The competition for this award was daunting. A total of 106 abstracts from young sleep researchers (i.e., within 5 years of having obtained the doctoral degree) were submitted to the National Sleep Foundation (NSF). Each submission was rated by a team of 3 established sleep researchers. From among these abstracts, the top 16 were chosen (8 "clinical research" abstracts and 8 "basic research" abstracts) and the authors received an all-expenses-paid trip to the Young Investigators Conference (held last Sunday) by the National Sleep Foundation in Washington, DC, where the investigators made oral presentations panels of experts and an audience. Based on a variety of criteria ranging from 'scientific impact' to 'presentation style', the panel selected a "winner" and a "runner up" from each category (basic and clinical). Dr. Rupp's winning entry was entitled "Sleep Extension Improves Performance and Facilitates Task Acquisition During and Following 7 Nights of Subsequent Sleep Restriction". In this work, Dr. Rupp showed that, contrary to current thinking, the recuperative value of extended sleep is "banked" until needed during subsequent sleep restriction.

As one of the two winners, Dr. Rupp will receive a small monetary award and will be treated to a week-long visit to the CDC in Atlanta. Of course, Dr. Rupp's award is clearly based on excellent skills and hard work. Her work also reflects very well on her mentor, Dr. Thomas Balkin and her colleagues in the Department of Behavioral Biology, Division of Psychiatry and Neuroscience at WRAIR. Congratulations, Dr. Rupp!

NRL All-Postdoc Poster Session—Spring 2007

18 National Research Council (NRC), American Society for Engineering Education (ASEE) and university supported postdoctoral associates presented their research to the Naval Research Laboratory (NRL) community at a poster session on May 16th sponsored by NRC and the NRL Women In Science and Engineering Network (WISE). The associates represented seven NRL Divisions (Optical Sciences, Chemistry, Materials Science and Technology, Electronics Science and Technology, Center for Biomolecular Sciences and Engineering, Remote Sensing, and Space Science) from three of the five NRL directorates and presented a broad range of topics from obital decay of a binary neutron star system to undersea aerobic environment fuel cells. The event was well attended with approximately 80 people viewing and discussing the posters including Dr. Basques, NRC Program Administrator, and Captain Gahagan, Commanding Officer of NRL. Spring sessions are sponsored by NRL-WISE; Autumn sessions are sponsored by Sigma Xi.