THE NATIONAL ACADEMIES

RESEARCH ASSOCIATESHIP PROGRAMS

The Postdoc

Winter 2013-2014

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NRC Adviser-Dean at AFIT

Dr. Adedeji B. Badiru (right) accepts the position as Dean of the Graduate School of Engineering and Management of the Air Force Institute of Technology, from Dr. Todd I. Stewart, AFIT Director and Chancellor.

Located at Wright Patterson AFB, AFIT is the Air Force's graduate school of engineering and management as well as its institution for technical professional continuing education.

The Air Force Institute of Technology formally welcomed their **new Dean of the Graduate School of Engineering and Management, Dr. Adedeji B. Badiru**, during a Change in Leadership Ceremony on Oct. 21, 2013. As dean, Badiru will be the senior academic officer responsible for planning, directing, and controlling all operations related to granting doctoral and master's degrees, professional continuing cyber education, and research and development programs.

In his inaugural message, Badiru stated ***"...I am excited and enthused about the opportunities that lie ahead of us. With the ongoing budget sequestration, our nation is facing a very tough fiscal environment. But, turbulent fiscal times require more resolve and determination to excel in whatever we do."***

Badiru is a Professor of Systems Engineering and previously served as Head of the Department of Systems Engineering and Management within AFIT's graduate school for seven years. Badiru holds a doctorate in Industrial Engineering from University of Central Florida. His research interests include mathematical modeling, project modeling and analysis, economic analysis, and productivity analysis and improvement.

The mission of AFIT is to advance air, space, and cyberspace power for our armed forces, the Nation, and its partners by providing relevant defense-focused technical graduate and continuing education, research, and consultation. AFIT accomplishes this mission through three resident schools: the Graduate School of Engineering and Management, the School of Systems and Logistics, and The Civil Engineer School. AFIT also manages all Air Force health, line, legal, and chaplain graduate education at civilian institutions.

"The Postdoc" newsletter, which highlights research and activities of NRC Associates, is available in print and on our website: http://sites.nationalacademies.org/PGA/RAP/PGA_047804.

Ray Gamble, Dir., NRC Postdoctoral Associateship Prgms.
Suzanne White (swhite@nas.edu), Newsletter manager

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

NRC Representation at 2014 Meetings

AIAA	American Institute of Aeronautics and Astronautics	01/13/14-01/17/14	National Harbor	MD
AMS	American Meteorological Society	02/02/14-02/06/14	Atlanta	GA
APS-RAP	American Physical Society	03/03/14-03/07/14	Denver	CO
Postdoc Conf	Postdoctoral Conference and Career Fair	04/24/2014	Bethesda	MD
EB	Experimental Biology	04/26/14-04/30/14	San Diego	CA
ASM	American Society for Microbiology	05/17/14-05/20/14	Boston	MA
ACS-Fall	American Chemical Society -- Fall	08/10/14-08/14/14	San Francisco	CA
FEF-McKNIGHT	FEF - McKnight Scholars Conference	10/01/14-10/01/14	Tampa	FL
HACU	Hispanic Association of Colleges and Universities	10/04/14-10/06/14	Denver	CO
MAES	Mexican American Engineers and Scientists	10/15/14-10/18/14	San Diego	CA
SACNAS	Soc for the Adv of Chicanos & Native Ams in Science	10/15/14-10/19/14	Los Angeles	CA
ASTMH	American Society of Tropical Medicine and Hygiene	11/02/14/11/06/14	New Orleans	LA
ABRCMS	Am Biomedical Research Conf for Minority Students	11/12/14-11/15/14	San Antonio	TX
AISES	American Indian Science and Engineering Society	11/13/14-11/15/14	Orlando	FL
AGU	American Geophysical Union	12/15/14-12/19/14	San Francisco	CA

Standing in front of Hurricane Gabrielle 2013 Research Mission Aircraft, Drs. Eric Uhlhorn, Rob Rogers (NRC), and Jun Zhang (NRC).

Dr. Paul Reasor, former NRC NOAA Associate, explains radar on aircraft to Dr. Jane Lubchenco, the head of NOAA at the time.

Follow 4 NRC Postdocs — NOAA Hurricane Res. Dev.

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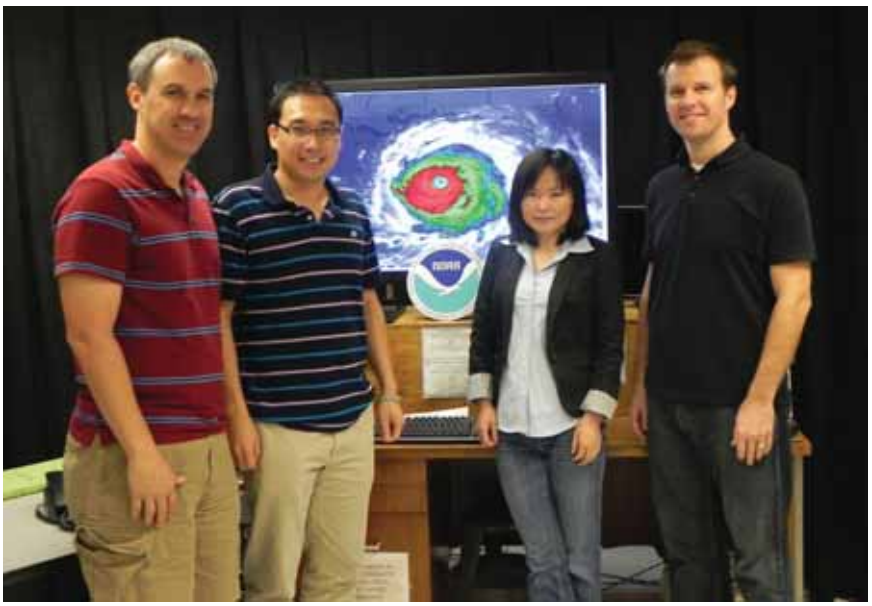

Left to right: Drs. Rob Rogers, Jun Zhang, Hua Chen, Paul Reasor, NRC Associates at NOAA

Graphene Saturable Absorbers for Mode-Locked Lasers

Using optically resonant structures to modify the linear and nonlinear attributes of graphene, researchers at Air Force Research Laboratory's Sensors Directorate have attained the largest modelocked pulse energies ever from semiconductor lasers. An optically pumped semiconductor laser was modelocked with this new graphene saturable absorber mirror – "G-SAM" for short – and was able to reach pulse energies of over 4 nJ and peak powers of almost 10 kW from a sub-picosecond stable modelocked laser.

Ultrafast laser pulses generated with modelocked lasers is at the forefront of science with applications from materials manufacturing, optical timing, chemical sensing, medical diagnostics, and 3D imaging. Development of the saturable absorber, a key component of the modelocked laser, has undergone significant development within the last several decades. These studies have focused on improving response time, robustness, and efficiency. The semiconductor saturable absorber mirror (SESAM), first employed in 1989, has developed the reputation as the workhorse of the field, owing to its high damage threshold, compact design, and ability to cover the optical spectrum from the visible through the infrared regimes through the selection of different materials.

However, the high performance of the SESAM is coupled with a complicated epitaxial growth structure, and operations regimes dictated by the materials included in the structure. As an alternative to this method, in 2009, graphene – a two-dimensional sheet of carbon atoms – was first demonstrated as a saturable absorber with a solid-state laser. Based on the atomic orientation of the carbon atoms, theoretical graphene has a band structure with a zero bandgap at the G-point, and no band curvature away from this, which results in extremely large electron mobility and a broadband, frequency-independent absorption of approximately 2.3% per layer. These qualities promise extraordinarily fast response time from the UV through to the infrared and even into the THz regime.

Graphene has been a popular choice for laser modelocking in recent years, achieving reasonably large pulse energies and demonstrating operation in the 1-3 µm optical wavelength bands. However, many have noted that the large insertion loss accompanying the materials have made it ineffectual for thin-disk lasers such as vertical external cavity surface-emitting lasers (VECSELs). This compact semiconductor laser has proven to be a popular device owing to its simple design, compact cavity, and open architecture, all of which have enabled over 100-W operation, and optical frequencies from the UV through to the THz regimes.

"We saw a method to control nonlinearities and losses in graphene saturable absorbers through optical confinement," says Dr. Saima Husaini, **NRC Associate with the Sensors Directorate, Air Force Research Laboratory**. Using a concept from the semiconductor world where an antiresonant structure was demonstrated to reduce the losses of SESAMs, the same concept could be utilized with graphene. To take advantage of this, the graphene would have to be located at a mirror, where counter-propagating fields could create a standing wave, and the graphene could be positioned according to functionality. Relative to the input field amplitude, if the graphene were positioned at a standing wave antinode, the field would be much stronger, and effects would be amplified (significantly reducing saturation fluences and increasing insertion loss). Likewise, if the graphene were positioned at a node, the effective saturation fluence would increase (because less field would be confined within the graphene), and would have significantly less insertion loss allowing the material to withstand much larger powers. Using this technique, we can vary the nonlinearities in the

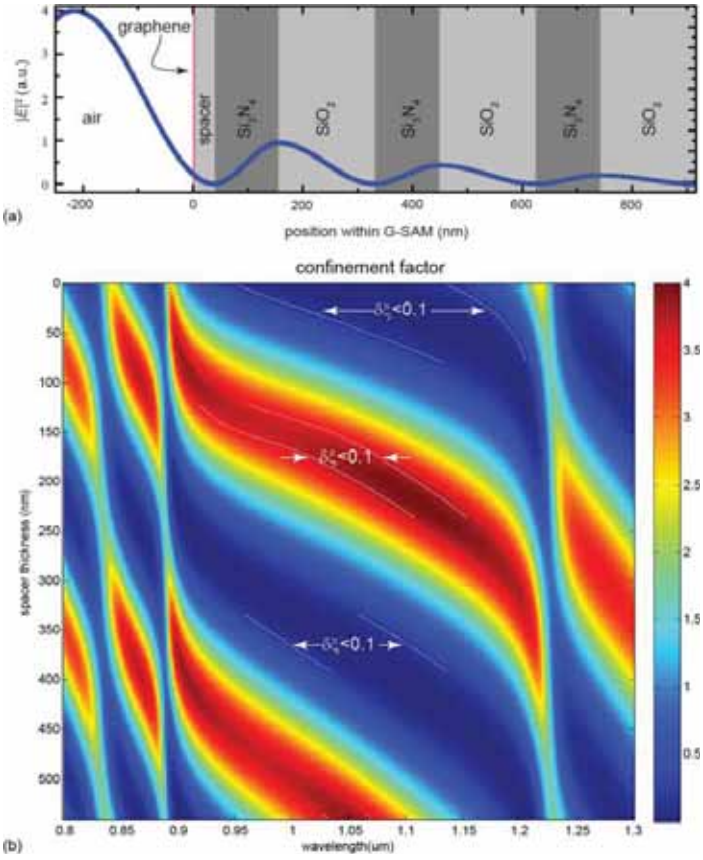

Figure 1 (a) longitudinal field distributed throughout the layers of the G-SAM structure. (b) "coupling coefficient" is the mode overlap with the graphene in the G-SAM as a function of wavelength and spacer thickness. Figure 1(b) shows how the field confinement changes with wavelength and spacer thickness.

graphene by a factor of ~10^{-3} to 4, depending on the exact G-SAM structure and the optical confinement within the graphene (x). This new structure, the "G-SAM", may hold the potential to allow proliferation of graphene modelocking structures across a wider variety of devices. The standing mode can be seen in Figure 1(a) for an antiresonant G-SAM structure at the designed wavelength.

To achieve low insertion loss, we demonstrated an antiresonant structure in which a field node is located in close proximity to the graphene layer. The antiresonant structure consists of graphene as the absorbing layer, a thin dielectric spacer layer, and a dielectric distributed Bragg reflector (DBR). The dielectric spacer's sole purpose is to tailor the field enhancement, in this case leading to a node near the graphene interface. The graphene layer negates the need to bandgap engineer the absorber, because its zero-point bandgap results in a uniform nonlinear optical response over a wide spectral region.

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The fast carrier-carrier scattering results in recovery times on the order of 100 fs, making it an ideal saturable absorber material for modelocking VECSELs. The DBR in our structure consists of nine periods of alternating layers of silicon dioxide and silicon nitride, and is centered at 1030 nm with a silicon dioxide spacer on top. The graphene layer is deposited via a transfer method. Chemical vapor deposition-grown graphene on copper foil is transferred to the desired substrate using polymethyl methcrylate (PMMA), which is subsequently removed. An example micrograph of the deposited graphene flakes can be seen in Figure 2(b). These devices were fabricated in the Sensors Directorate 6000 sq-ft class 100 cleanroom, which has a wide variety of fabrication capabilities ranging from electronic and photonic epitaxial growth methods to various lithography and etching techniques. This is complimented with Sensors Directorate's thorough host of optical and electrical analysis techniques from materials analysis to device measurements.

The graphene was analyzed using Raman spectroscopy to assure the quality of the graphene layer, and to differentiate between graphite, multi-layer graphene, and pure (i.e. single-layer) graphene. In our case, fitting the *2D* peak of the Raman spectra to a single Lorentzian with a relatively narrow frequency width (<60 cm^{-1}), indicated that the graphene behaved as single, uncoupled sheets of carbon. Moreover, our small *D* peak identifies the high quality nature of the film, with few defects and wrinkles.

We also analyze the material's nonlinear response via *z*-scan, where the fluence is adjusted and transmission through the graphene is measured as a function of this fluence. The intensity dependent absorption consists of a saturation term (where absorption decreases with increasing fluence) and an optical limiting effect (absorption increases at larger fluences). Our measurements show that for powers up to 10's of GW/cm^2, saturable absorption is the dominant term, making for an ideal saturable absorber for a modelocked laser. We chose to demonstrate the G-SAM with a VECSEL. Similar to a vertical-cavity-surface-emitting-laser (VCSEL), the VECSEL's low-power cousin, a VECSEL can be thought of as a half-VCSEL, with one mirror removed and replaced with a curved external mirror. This change to the VCSEL allows one to scale the gain volume without exciting higher transverse optical modes in the laser, as simple power-scaling VCSELs would. As such, VECSELs operate at the Watt level, as opposed to milliwatt output powers VCSELs typify. These lasers have been investigated for various applications by the Air Force for almost 10 years by the **Sensors Directorate group headed up by NRC Advisor, Dr. Robert Bedford**. Using VECSELs, the Sensors group has explored high brightness VECSELs operating in the ~900 nm to 2100 nm band. They've developed near-infrared lasers with 10's of Watts of CW operation operating in a single mode, over 100 W of CW power at 1-micron, novel cavities including nonlinear components which frequency-double light to achieve several Watt sources in the visible- and ultraviolet-spectra. They've also investigated RF frequency responses of VECSELs for evaluation for RF photonics applications, novel coupled cavity lasers for optical switching and power scaling, and quantum confined effects for mitigating loss currents in semiconductors.

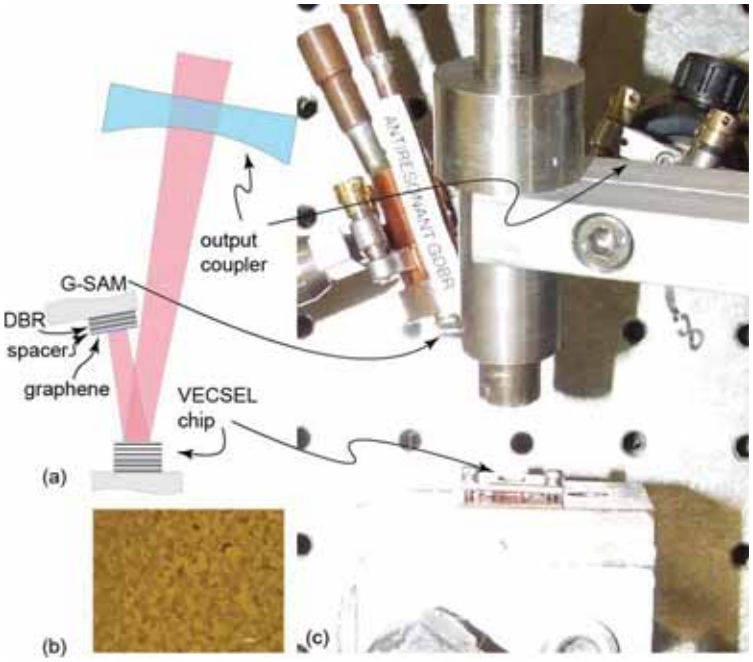

Figure 2 (a) schematic of a VECSEL for mode-locking, including the G-SAM, VECSEL chip, and the output coupler. (b) micrograph of graphene flakes deposited via transfer method. (c) Image of optically-pumped VECSEL, all components identified in (a).

A schematic of a V-cavity VECSEL is pictured in Figure 2 (a). The waist of the supported Gaussian mode is located at the G-SAM, which is defined between the G-SAM and the curved output coupler. The otherwise linear cavity is folded about the gain chip, where a pulse traversing the cavity sees twice in a round-trip. Figure 2(c) is a photograph from above the VECSEL cavity – perspective similar to 2(a).

As stated earlier, one of the many attractive features of VECSELs it the high-power capability. The VECSEL chip is mounted on a heat sink maintained at 13°C for temperature control, and is pumped using a fiber coupled laser diode operating at 808 nm. The total length of the cavity is 8.5 cm, corresponding to a round-trip pulse time of just over 0.5 ns. We are able to achieve 6.7 W out of a VECSEL cavity without any roll-over, which can be seen in the power output Figure 3(a). More recently, small changes have resulted in demonstrated average powers in excess of 10 W. An increase in input power also results in a decrease in the pulsewidth of the system since the higher pumping results in greater saturation of the graphene [also plotted in Figure 3(a)]. The optical spectrum bandwidth also changes with input pump power, maintaining nearly bandwidth limited pulses throughout the entire region of interest.

The beam quality this cavity output was also studied and although the beam quality factor M^2 changes with an increase in pump power, all values of M^2 recorded for our range of interest did not exceed 1.5 on either axis, confirming the laser did not generate an appreciable amount of power in a higher-order Hermite Gaussian transverse mode, which would ultimately affect the maximum achievable power densities and minimum diffraction angle through the atmosphere.

Because modelocked optical pulses are often too short to resolve directly, the most common technique for characterizing pulses is through autocorrelation. In this method, a pulse divided by a beam splitter, and recombined with itself, where one beam is de-

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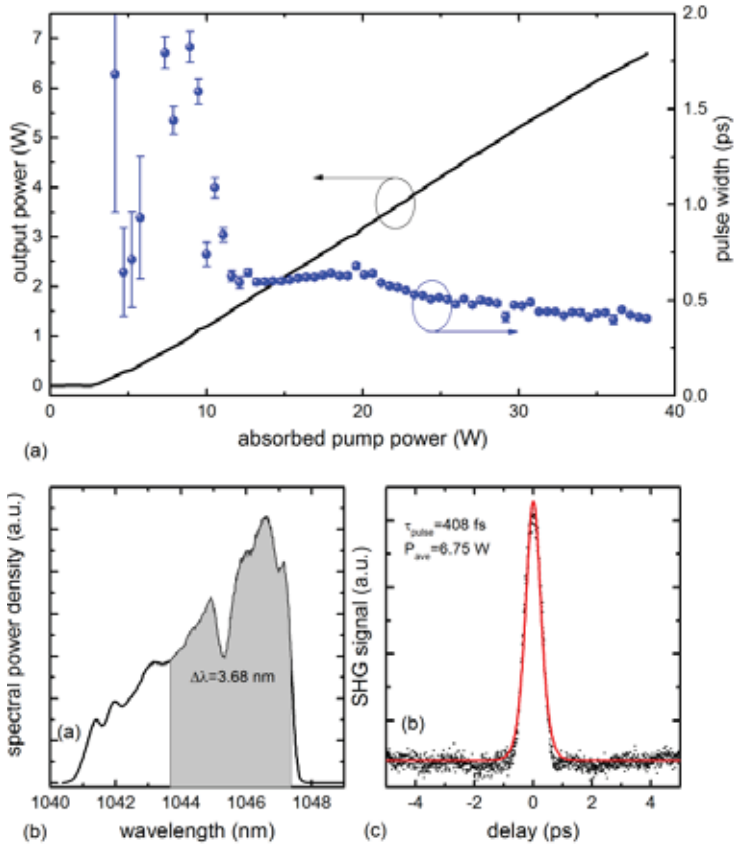

Figure 3 (a) Power and pulse width as a function of absorbed pump power. (b) and (c) are optical spectrum and pulse autocorrelation at the maximum average output power.

layed relative to the other. An intensity-dependent nonlinearity (such as second-harmonic generation) is then used to determine how the beams interact with each other, giving a sense of the pulse dynamics. The optical spectrum and autocorrelator spectra for this cavity are presented at an output power of 6.7 W [Figure 3(b) and Figure 3(c)]. The emission spectra as shown in Figure3(b) displays an asymmetric optical spectra with a full-width half-maximum of 3.68 nm centered at an approximate wavelength of 1046 nm. The corresponding autocorrelated pulse is shown in Figure 3(c) which results in a pulse with a temporal width of 408~fs corresponding to an essentially Fourier transform limited pulse.

At this date, this is the highest reported modelocked power from a VECSEL. These pulses are sub-picosecond pulses of ~3.8 nJ, and peak powers of almost 10 kW from a semiconductor chip. Subsequent tests where we increased the cavity length to produce a repetition frequency of 1.33 GHz resulted in output pulse energies of 4.5 nJ, unusually larger for semiconductor lasers. Further with minor adjustments, the average power can be scaled to over 10 Watts. This work has resulted in a patent application filed with the USPTO. Moreover, there was no damage to the G-SAM, verifying that the antiresonant configuration seems to protect the G -SAM, even at high peak powers (e.g. 10 kW peak powers outside the cavity correspond to 0.5 GW peak powers within the cavity). Graphene saturable absorber mirrors are proving to change the future of both graphene saturable absorbers as well as VECSELs, opening up the way for large pulse energy semiconductor modelocked lasers.

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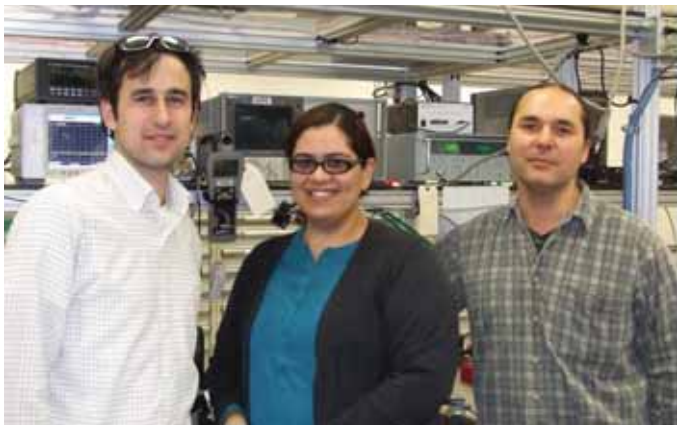
Smith, et al., JOSA-B, 2, 1228 (1985).
Breusing, et al., PRL, 102, 086809 (2009).
Keller, et al., OL, 17, 505 (1992).

Work was conducted through an postdoctoral proposal NRC Associate Dr Saima Husaini. Dr Husaini received her Ph.D degree in Physics from the Graduate School at the City University of New York. Her work has focused on the nonlinear optical characterization and development of photonic structures embedded with hybrid composites consisting of metal nanoparticles, quantum dots and more recently graphene.

Author: Dr. Robert Bedford, NRC Advisor, Air Force Research Laboratory, Optoelectronic Components Branch (AFRL/RYDH), Wright-Patterson AFB, OH 45433.

Author Bio: Dr. Robert Bedford is a Senior Electronics Engineer with the Optoelectronic Components Branch of AFRL near Dayton, OH. He received his Ph.D. in Optical Sciences from the Optical Sciences Center, University of Arizona. He has primarily investigated the area of high-brightness semiconductor lasers and functional devices across many spectral regimes and for various applications.



Semiconductor Laser Team (left to right): Dr. Charles Reyner, Dr. Saima Husaini NRC Associate, and Dr. Robert Bedford. Missing: Mr. Tuoc Dang.

Where is he now?

In 1998,Tyrel Johnson was one of two co-winners of the [NASA] Chandra-Naming Contest to name the Advanced X-ray Astrophysics Facility (AXAF). Entering the contest as a 10th grade student at Priest River Lamanna High School in Priest River, Idaho, Tyrel submitted the name "Chandrasekhar" in honor of the great physicist Subrahmanyan Chandrasekhar. Chandrasekhar calculated the maximum mass for a white dwarf star and the increase in electron degeneracy pressure as a white dwarf star contracts under gravity, and he did it all on a Brunsviga calculator over a period of about four or five months.

The grand prize, contributed by TRW, the prime contractor for Chandra, was a trip to see the launch of Chandra. We recently touched base with Tyrel to see where he is now.

Left: Mrs. Lalitha Chandrasekhar with Tyrel Johnson

Tyrel Johnson is currently a National Research Council Associate at the Naval Research Laboratory (NRL), Washington, DC, where he is a member of the Large Area Telescope collaboration for the Fermi Gamma Ray Space Telescope.

NPS News

Michal Kopera, NRC Associate at Naval Postgraduate School (NPS) submitted ***Analysis of adaptive mesh refinement for IMEX discontinuous Galerkin solutions of the compressible Euler equations with application to atmospheric simulations*** to the Journal of Computational Physics: **http://faculty.nps.edu/fxgirald/Homepage/Publications_files/Kopera_Giraldo_JCP_2013_submitted.pdf**

Dr. Michal Kopera, NRC Associate at NPS

Abstract:
The resolutions of interests in atmospheric simulations require prohibitively large computational resources. Adaptive mesh refinement (AMR) tries to mitigate this problem by putting high resolution in crucial areas of the domain. We investigate the performance of a tree-based AMR algorithm for the high order discontinuous Galerkin method on quadrilateral grids with non-conforming elements. We perform a detailed analysis of the cost of AMR by comparing this to uniform reference simulations of two standard atmospheric test cases: density current and rising thermal bubble. The analysis shows up to 15 times speed-up of the AMR simulations with the cost of mesh adaptation below 1% of the total runtime. We pay particular attention to the implicit-explicit (IMEX) time integration methods and show that the ARK2 method is more robust with respect to dynamically adapting meshes than BDF2. Preliminary analysis of preconditioning reveals that it can be an important factor in the AMR overhead. The compiler optimizations provide significant cant runtime reduction and positively affect the effectiveness of AMR allowing for speed-ups greater than it would follow from the simple performance model.

A **podcast** of Michal's presentation —***Adaptive mesh refinement for discontinuous Galerkin method on quadrilateral non-conforming grid*** — at the Isaac Newton Institute, University of Cambridge (**http://www.newton.ac.uk/programmes/AMM/seminars/2012092516351.html** got over 300 views from 37 countries making it the most viewed presentation of the Newton Institute program for Multiscale Numerics for the Atmosphere and Ocean. Published Research page:**http://faculty.nps.edu/makopera/research.html**

NPS News

Dr. Simone Marras, NRC Associate at NPS

Another **NRC Associate at NPS**—**Simone Marras**—submitted ***An LES-like stabilization of the spectral element solution of the Euler equations for atmospheric flows*** to the 11th World Congress on Computational Mechanics.

Abstract:
The solution of the Euler equations by the spectral element method (SEM) is subject to oscillatory behavior if the high-frequency modes are not damped in some way. In this analysis, we extend to high order spectral elements and to low-Mach number flows the recent work by Nazarov and Hoffman [1], where an LES-like physical diffusion acts both as a localized and controlled numerical stabilization for finite elements and as a turbulence model for compressible flows. In the framework of high-order SEM for the solution of the low-Mach number flows, this approach is a possible physics-based alternative to the variational multiscale stabilization (VMS) method that the authors successfully applied to the SEM solution of the advection diffusion equation [2] in the context of atmospheric flows. Like for VMS, stabilization is obtained by means of a residual-based term that is added to the inviscid Euler equations. Unlike VMS, however, this extra term is based on purely physical –rather than numerical– assumptions, in that it is related to the viscous component of the stress tensor of the Navier-Stokes equations. The method is tested with pseudo and fully 3D simulations of idealized nonhydrostatic atmospheric flows and is verified against data from the literature. This work represents a step toward the implementation of a stabilized, high order, spectral element LES model within the Nonhydrostatic Unified Model of the Atmosphere [3, 4] developed by the authors.

NPS News

Dr. Andreas Mueller, NRC Associate at NPS

Andreas Mueller, yet another NRC Associate at NPS was invited Travel to the Technical University of Munich.

Topic:
For discussing current challenges of numerical weather prediction and how invasive computing might help in future Andreas Mueller was invited by the Technical University of Munich 12/212/2013.

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NPS News

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NPS News

Invasive computing aims at adapting the amount of the computational resources during the runtime of a computer simulation to the current needs of the simulation. For allowing this kind of dynamic adaptation new programming concepts, languages, compilers and operating systems are necessary.

The 4 year program InvasIC of the German Research Foundation aims at developing these new tools (**http://invasic.informatik.uni-erlangen.de/en/index.php**). One possible application of invasive computing will be the weather forecast. By using invasive computing the weather forecast could increase the amount of resources used when extreme weather events like Hurricanes and severe precipitation events occur. It is expected that this adaptation would improve the accuracy of the forecast of those severe weather events. During his visit, Andreas gave a presentation in the InvasIC seminar with the title *Computational and Numerical Challenges in Weather Prediction* (**http://invasic.informatik.uni-erlangen.de/en/events.php**). Furthermore strategies for measuring and improving the efficiency of NUMA (**http://faculty.nps.edu/fxgirald/projects/NUMA/Introduction_to_NUMA.html**) were discussed with the computer scientists in Munich.

Dr. Frank Giraldo, NPS NRC Adviser of Michal, Simone, and Andreas

NPS ARSENL Fleet of Unicorn UAVs

NPS ARSENL New Opp

Dr. Timothy H. Chung
Naval Postgraduate School
thchung@nps.edu

The NPS Advanced Robotic Systems Engineering Laboratory (ARSENL) is developing technologies and capabilities for deployment and employment of large teams of unmanned aerial systems. These low-cost aerial robots may serve as wide-area sensors and communication relays, and serve as an experimental testbed for autonomous coordination and tactical algorithms. FY13 has been a year of exponential growth for ARSENL. We have flown in seven field experiments, including the following NPS hosted experiments: JIFX 13-2, RELIEF 13-3, TNT 13-3, and JIFX 13 -4. We were able to conduct 75 Unicorn sorties and 30 Zephyr sorties during these field events. Data collection from these live-fly experiments has enabled the lab, which started flying one Unicorn UAV made by Procerus Technologies (a Lockheed Martin company) in October 2012, to dramatically increase and fly ten Unicorns at one time in May 2013! While flying ten planes at one time was a logistically taxing, especially on the ground control station operators and flight technicians; a lot of research, testing, and energy has been put into rapid development of the Zephyr UAV, which uses open-source and low-cost hardware / software.

Basic UAV swarming missions were also carried out with swarms of size 3. We expect to expand the swarms to larger sizes in the coming year, with custom behaviors for each swarm (e.g., engage target, defend ally, search, survey). Note that 'engage target' can have many applications, from agricultural (spray pesticide), to search-and-rescue (deliver survival kit), in addition to various military applications.

NPS ARSENL is currently advertising a NRC RAP Opportunity RO# 62.10.03.B7829, entitled ***Systems Integration of Perception and Control for Swarm versus Swarm Autonomous Aerial Robots.***

Dr. Kevin Jones, NPS Prof. (left), and LT Dave Adams, USNR (right) prepare the ARSENL Zephyr UAV

NEW NPS news

ARSENL summer intern Matthew Epperson (foreground) works with Dr. Chung and his research and student team

CAPT Dave Harach, USNR, launches a Unicorn UAV

Dr. Berninger checking a composite water sampling device during a recent field study near Lake Erie

Lemon Shark inspired career in aquatic toxicology

"I had dreamed of becoming a scientist in general, and a paleontologist in particular, ever since the Tyrannosaurus skeleton awed and scared me at New York's Museum of Natural History when I was 5 years old."

– Stephen Jay Gould, Rocks of Ages: Science and Religion in the Fullness of Life (1999)

My own Tyrannosaur was a lemon shark (*Negaprion brevirostris*) at the Cincinnati Zoo when I was about that same age. The powerful presence of this living creature held forth here for my kindergarten-self to observe seared itself into my brain, locking in those neurons which would direct me to a biological life. That intellectual T. rex, struck again when I was twenty only in the form of an orangethroat darter (*Etheostoma spectabile*), held gently in my hands while kneeling in a creek, still cold with spring rains. That beautiful little fish, shimmering orange, green, and blue in the April sun, showed me the steps to the path that would lead me to becoming a biologist. What I later realized was that for others to have that same transformative moment, those fish and the water where they live must be protected. So my career path transitioned from enthusiastic student, to biologist, to ichthyologist, to environmental researcher.

My undergraduate life saw my introduction to molecular ichthyology, looking at genetic differences between behaviorally divergent salmon populations. My Master's work focused on using molecular techniques to identify changes in population genetics associated with differences in metal concentrations, particularly those associate with anthropogenic impacts in pristine environments. Later, working with a US EPA contractor, I was able to use my skills as an ichthyologist and an environmental scientist through the course of many field and laboratory projects. My doctoral work focused on understanding and prioritizing the risk/hazard of environmental contaminants. As I moved into my NRC Associateship, I felt confident that I would be able to utilize all those hard acquired skills in challenging and cutting edge research being done at the US EPA Midcontinent Ecology Division Laboratory.

As an NRC Associate, I work with a team of talented scientists at the US EPA to develop novel and innovative approaches to environmental assessment and monitoring for chemical toxicity. The EPA Mid-Continent Ecology Division (MED), where I hold my appointment, has long been known as source for high quality environmental science and aquatic toxicology, and is in large part responsible for many of the standard monitoring and assessment methods within the Agency, nationally, and internationally.

This history of high quality research resulting in improved environmental practice was one of the primary reasons I applied for my fellowship at this lab. The other reason was the opportunity to work with the EPA scientists, many of whom are considered global experts within the field of aquatic toxicology.

Most of my research focuses on chemicals of emerging concern (CECs). This category, CECs, is a catch-all for a wide swath of compounds with limited (often non-existent) regulatory criteria and rudimentary (if any) aquatic toxicological profiles. While continually improving analytical techniques can detect these chemicals in aquatic systems, little in known about their potential effects on organisms. My research focuses on two areas: prioritizing CECs based on available data, and applying molecular and omics approaches to field studies. Working with two world class scientists as mentors, Dr. Gerald Ankley and Dr. Daniel Villeneuve, as well as a support team of extraordinary scientists, I have been able to work on a number of different projects which are expected to advance the field.

Much of my work has focused on the development and refinement of effects-based aquatic testing and monitoring. Effects-based monitoring thus far has been focused on short-term whole animal toxicity endpoints. While these data are incredibly powerful, the power is retrospective, identifying problems only after they have reached the point of causing adverse effects. As identified in National Research Council's "Toxicity Testing in the 21st Century" testing (and monitoring) strategies need to move away from whole organism testing towards more molecular and *in vitro* evaluations. The approach to accomplishing this and the focus of much of my research is the utilization of the "adverse outcome pathway" (AOP).

This approach recognizes that pathways are involved, initiated by a chain of events starting with an exposure and leading along increasing levels of biological organization until it reaches impacts on the population level. The adverse outcome pathway approach, defined and championed by the EPA researchers at MED, provides a framework that links this response pathway to events that are important to established regulatory endpoints (e.g., mortality, development, reproduction and extirpation). In the lab, much work has been done to establish key chemical and biological events and links between these levels of biological organization; the focus, and primary challenge of my research, is to transition these concepts to the field.

In the field, this AOP-focused effects-based monitoring provides a means to evaluate complex environments with multiple stressors in a way that is not possible through traditional chemical-based assessment. Our research efforts are focused on using caged fathead minnows (*Pimephales promelas*; the white rat of aquatic ecotoxicology) as a means to monitor biological response to the environment. While this is still a whole organism *in-vivo* test, by evaluating multiple endpoints from within each single fish, overall we are able to increase the volume of information gathered, while decreasing the overall number of fish used per evaluation. Fish are exposed in the field for anywhere between 6 hours and 15 days, depending on the study.

The fish are necropsied and multiple tissues are collected, including liver, gonad, blood/plasma, brains/pituitary, thyroid enriched tissue, gills, and brains (we also save the remaining tissue for chemical analysis.

My favorite analogy for this process is that the fish are "parted out like a stolen Camaro". Multiple assays are done including transcriptomics, metabolomics, targeted qPCR, measurements of steroid hormones and vitellogenin

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(a key biomarker for exposure to endocrine active compounds). Aside from the development of the field studies, one of my primary duties has been to assimilate this plethora of data into information that is useful to scientists and eventually regulators. This has taken the form of presentations at national meetings (Society of Environmental Toxicology and Chemistry) and several manuscripts, the first of which was just accepting into Environmental Science and Technology.

The other major project I am involved with focuses on the prioritization of CECs for evaluation. One of the major groups of CECs are pharmaceuticals, which we now know are found in virtually every municipal effluent. The concern with human and veterinary drugs is that they are biologically active, engineered to cause a specific biological effect in a target organism. While typically targeted at humans or other mammals, given the overall conservation of the critical targets, there is great potential for effects in non-target organisms, particularly aquatic species, like fish and macroinvertebrates.

Of the 5000 or so active pharmaceutical ingredients, only a handful have been evaluated for chronic (non-lethal) effects in aquatic organisms, and even those tested have not been evaluated for their specific biological consequences of the drug action. The research we are doing here at MED focuses on a multi-faceted approach to prioritization. There are several key elements to our approach, including: evaluation of protein sequence similarity (to identify the likelihood of response in non-target organisms), identification of molecular modes of action (MOA), and mining the vast repositories of pharmacological development data.

The focus of my work is to develop a read-across, from mammals (where there is an enormous data set of pharmacokinetic/dynamic information), to fish (and other aquatic organisms), where little data exists. By mining the mammalian literature and databases I have developed an extensive, fully referenced database. It currently contains information for 1400 drugs and 120 therapeutic classes, and includes physical properties, pharmacokinetics, toxicity and therapeutic dose parameters. The database forms the core of a computer application that utilizes probabilistic distributions to prioritize pharmaceuticals. These prioritizations can take the form of individual parameters or multi-parameter assessment, and in use of the probabilistic approach given the program the ability to assess both drugs in the database and those not yet included, or even unknown.

My work will be incorporated into a larger overall framework which includes specific information about the adverse outcomes based on MOA and the molecular target similarity. In our research here at MED we have utilized the database and program in a number of different ways. As part of our developing monitoring and assessment program for CECs, I used the program to identify a prioritized list of drugs for inclusion into our analytical chemistry evaluation. We have also used it to identify compounds for study for several MOA specific analyses. Further we are currently using it to develop a list of target compounds for the assessment of the mammal to fish read-across approach, specifically understanding how mammalian pharmacokinetic responses might translate in fish.

My time at the EPA in Duluth, MN has provided me an opportunity to hone my skills and develop as a scientist. I have been afforded the opportunity to develop some unique and challenging projects. I am also allowed an inside look at the development of environmental monitoring and assessment directed at policy and methods. The tests and approaches, codified into regulatory endpoints, provide a repeatable and simplified way to assess the environment, but they did not all start that way. They start with an idea: "how things can be done better?" "How can we better protect the environment?" that progresses into testing, application and analysis of the results, and re-evaluation, in an iterative process to identify approaches that work and fix or discard those that do not. All along the way important considerations, like reducing the number of organisms or moving towards more *in vitro* assays, are incorporated into the framework. Working with the world class researchers here has challenged me to become a better writer, presenter, investigator, and overall a better scientist.

Dr. Jason Berninger, NRC Associate at EPA

"***As a scientist, I am always looking for my next "T-rex" moment, that moment of terrified astonishment, that spike of intellectual adrenaline that will drive my curiosity and creativity into the next evolution of my career. Along the way I also hope that I can inspire that moment in those around me through mentoring, teaching, or just inspired collaboration with fellow scientists. Moving into my third year of my post-doc and looking to the future, and what that next step will be, I know that no matter where that it is, my time at the EPA-MED lab will have served me well. "***

Jason Berninger
NRC Post Doc at US EPA
Duluth, Minnesota Area | Government Administration
Previous Baylor University
Education Baylor University
Connect Send Jason InMail

Edit experience Previous Baylor Uni-

NRL's VERIS instrument obtains first subarc-second resolution EUV spectra and images of the solar atmosphere

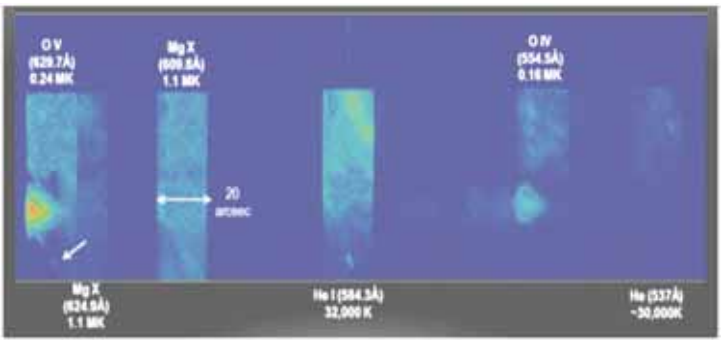
The U.S. Naval Research Laboratory's (NRL's) VEry high angular Resolution Imaging Spectrometer (VERIS) has obtained the first sub-arcsecond spectrally pure images of the solar atmosphere. VERIS launched from the White Sands Missile Range in New Mexico on August 8, 2013.

VERIS was designed by NRL's Space Science Division and sponsored by NASA. Its goal is to uncover the fundamental structure of the solar atmosphere by obtaining sub-arcsecond Extreme Ultraviolet (EUV) solar spectra. Early results from VERIS show payload-imaged solar features less than one arc-second in size. VERIS measures properties of the structures in the sun's upper atmosphere with a factor of four higher resolution than similar instruments already in orbit. The bright regions in this solar image, known as active regions in the solar atmosphere, are areas that can spawn giant eruptions on the sun. The VERIS rocket studied the physical properties of these regions in exquisite detail during its 15-minute flight in early August 2013.

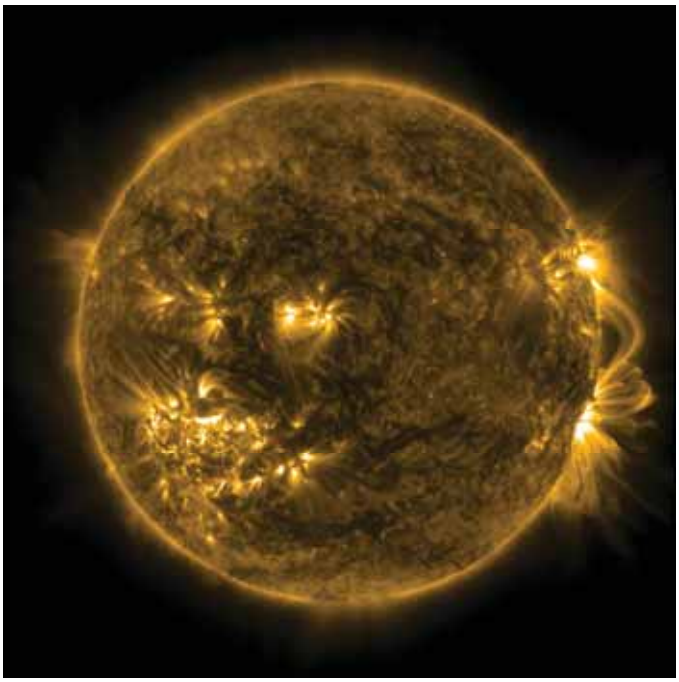
As part of the NASA Low Cost Access to Space program, VERIS is a testbed for observing from the solar chromosphere through the solar corona with ultra-high spatial and spectral resolution. The VERIS instrument, with a mirror that is 6 inches in diameter, spans almost 10 feet in length and weighs almost 500 pounds. An instrument of this size is too large to fly on a satellite, but is a good match for a sounding rocket. It was designed and built by NRL's Dr. Clarence Korendyke and his team to observe the properties of the building block structures of the solar atmosphere in solar active regions, the quiet part of the sun, and in solar flares, over the full temperature range of the solar atmosphere. "On the sun, large scale energy releases are driven by small scale physical processes," explained Dr. Korendyke, VERIS Principal Investigator, "So we need to look at and understand the details of those processes." Knowledge of solar EUV emission variability gained from VERIS, Dr. Korendyke explains, will provide improved ability to forecast space weather at earth that adversely affects satellite communications and space asset tracking and situational awareness.

A first look at the data captured by VERIS shows a spatially resolved Helium spectrum and spectrally pure images in a number of EUV emission lines. Some of the measured solar structures were less than one arc-second in size. Although the VERIS flight only obtained six minutes of observing time above the earth's atmosphere, scientists will spend years analyzing the data collected during the flight.

The VAULT rocket taking off towards its first (successful) mission



VERIS first light image. VERIS is able to image multiple lines simultaneously covering the temperature range from the chromosphere to the corona. The white arrows mark the location of a sub-arcsec feature emitting in two widely different temperatures simultaneously (MgX and HeI).



The bright regions in this solar image, known as active regions in the solar atmosphere, are areas that can spawn giant eruptions on the sun. The VERIS rocket studied the physical properties of these regions in exquisite detail during its 15-minute flight in early August 2013.

The VAULT team posing with their NASA Mission Manager in front of the locked and loaded rocket. From left to right are Dr. Clarence Korenydke, Dave Roberts, Kevin Eisenhower, Angelos Vourlidas, Christine Powers (NASA), Dr. Jeff Morrill, Dr. Samuel Tun Beltran, NRC Associate, and (not pictured) Dr. Damien Chua, former NRC Associate of the NRL Space Science Division's Solar and Heliospheric Physics Branch.

NPS News

Sufian Alnemrat, NRC Associate at Naval Postgraduate School, 2012. His research interests include explosives, shock physics, and material behavior at extreme conditions. Current projects include the chemical decomposition and environmental transport of explosives and simulations of new explosives and fuel nanomaterials.

AIP | Applied Physics Letters — FREE ACCESS THROUGH 2013

Adsorption of 2,4,6-trinitrotoluene on the ZnO (2 1 ¯1 ¯0) surface: A density functional theory study of the detection mechanism of ZnO nanowire chemiresistors

Sufian Alnemrat, Gary T. Brett, and Joseph P. Hooper

Citation: Applied Physics Letters **103**, 173102 (2013); doi: 10.1063/1.4825365
View online: http://dx.doi.org/10.1063/1.4825365
View Table of Contents: http://scitation.aip.org/content/aip/journal/apl/103/17?ver=pdfcov
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Predicting Solubility of Military, Homemade, and Green Explosives in Pure and Saline Water using COSMO-RS

Sufian Alnemrat[a] and Joseph P. Hooper*[a]

Abstract: The conductor-like screening model for real solvents (COSMO-RS) has previously been shown to give accurate aqueous solubilities for a range of organic compounds using only quantum chemical simulation data. Application of this method for solid organic explosives, however, faces two difficulties; it requires correction for the free energy of fusion (a generally unknown quantity for these compounds) and it shows considerable error for common explosive classes such as nitramines. Herein we introduce a correction factor for COSMO-RS that is applicable to a wide range of explosives, and requires no data beyond a quantum chemistry calculation. This modification allows COSMO-RS to be used as a predictive tool for new proposed explosives or for systems lacking experimental data. We use this method to predict the temperature-dependent solubility of solid explosives in pure and saline water to an average accuracy of approximately 0.25 log units at ambient temperature. Setschenow (salting-out) coefficients predicted by this method show considerable improvement over previous COSMO-RS results, but are still slightly overestimated compared to the limited experimental data available. We apply this method to a range of military, homemade, and "green" explosives that lack experimental seawater solubility data, an important property for environmental fate and transport modeling.

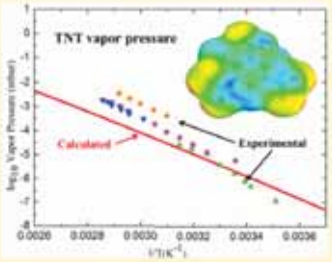
Predicting Temperature-Dependent Solid Vapor Pressures of Explosives and Related Compounds Using a Quantum Mechanical Continuum Solvation Model

Sufian Alnemrat and Joseph P. Hooper*

Department of Physics, Naval Postgraduate School, Monterey, California 93943, United States

Supporting Information

ABSTRACT: Temperature-dependent vapor pressures of solid explosives and their byproducts are calculated to an accuracy of 0.32 log units using a modified form of the conductor-like screening model for real solvents (COSMO-RS). Accurate predictions for solids within COSMO-RS require correction for the free energy of fusion as well as other effects such as van der Waals interactions. Limited experimental data on explosives is available to determine these corrections, and thus we have extended the COSMO-RS model by introducing a quantitative structure−property relationship to estimate a lumped correction factor using only information from standard quantum chemistry calculations. This modification improves the COSMO-RS estimate of ambient vapor pressure by more than 1 order of magnitude for a range of nitrogen-rich explosives and their derivatives, bringing the theoretical predictions to within typical experimental error bars for vapor pressure measurements. The estimated temperature dependence of these vapor pressures also agrees well with available experimental data, which is particularly important for estimating environmental transport and gas evolution for buried explosives or environmentally contaminated locations. This technique is then used to predict vapor pressures for a number of explosives and degradation products for which experimental data is not readily available.



continued from previous page—Dr. Sufian Alnemrat, NRC Associate at Naval Postgraduate School

IOPscience

NPS News

The role of equilibrium volume and magnetism on the stability of iron phases at high pressures

S Alnemrat[1,2] , J P Hooper[2] , I Vasiliev[1] and B Kiefer[1]

[1] Department of Physics, New Mexico State University, Las Cruces, NM 88003, USA
[2] Physics Department, Naval Postgraduate School, Monterey, CA 93943, USA

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NPS News

Physical Review B
condensed matter and materials physics

Oxidation of ligand-protected aluminum clusters: an ab-initio molecular dynamics study

Sufian Alnemrat and Joseph P. Hooper

Physics Department, Naval Postgraduate School, Monterey, CA 93943

Under Review

NRC Adviser/Army Researcher — Outstanding Distinguished Graduate Alumni Award

USAISR researcher Victor A. Convertino Ph.D. (left) receives the Outstanding Distinguished Graduate Alumni Award Oct. 10 from Dr. James E. K. Hildreth, Dean of the College of Biological Sciences at the University of California, Davis

A physiologist/researcher and **NRC Adviser from The US Army Medical Research and Materiel Command U.S. Army Institute of Surgical Research received the Outstanding Distinguished Graduate Alumni Award from the University of California, Davis College of Biological Sciences.**

Dr. Victor A. Convertino, the tactical combat casualty care research task area program manager, accepted the award during a ceremony at Davis, California, October 10, 2013.

"I am very humbled and honored to have received a career award from an institution that holds national rankings in the top 10 for public universities and in the top 50 in life sciences and medicine research," said Convertino. ***"But I'm most deeply touched by the respect that I've received by my colleagues. I hold a deep appreciation that no individual recognition accurately reflects a lifetime of support from family, friends, teachers, and colleagues who've made every accomplishment possible. This lifetime team includes the support and contributions of past and present members of the tactical combat casualty care research task area here at the USAISR."***

Nomination letters written by Convertino's colleagues to support this award stated that he was instrumental in the development of exercise countermeasures for astronauts and high-performance aircraft pilots with translational application to the care of special populations such as patients who are bedridden or wheelchair-restricted.

He was also involved in research that supported the development of advanced technologies for application in military medicine that are designed to optimize combat casualty care by providing early diagnosis and treatment of life-threatening low-tissue perfusion during out-of-hospital care.

Among the several combat casualty care research projects that Convertino has participated in since joining the USAISR in 1998 are the impedance threshold device and compensatory reserve index algorithm. The ITD increases low blood pressure in spontaneously breathing patients and the CRI algorithm utilizes the information obtained from a standard pulse oximeter and gauges whether a patient requires resuscitation or immediate medical attention.

In his acceptance speech, Convertino read an excerpt from an e-mail that he received from the chief of emergency medicine deployed at the 228th Combat Support Hospital in Baghdad, Iraq in June 2007. The note stated that a soldier with a gunshot wound to the pelvis was brought to the emergency room. The patient was in shock with low blood pressure and the medical staff was having problems finding a vein to start an IV. After an injection with a medication to raise the blood pressure failed, the medical staff placed a breathing value (ITD) which raised the blood pressure allowing an IV to get started. The patient was stabilized and sent to the operating room for surgery.

"I couldn't think of anything that better defines the value of an education," he said. "And the opportunity to serve our Nation's military who defends the freedoms that we enjoy. I'm deeply grateful for such opportunities."

NSRDEC

Chris Doona enters IFT Hall of Honor

Right, Dr. Christopher Doona, former NRC Associate, and currently a physical chemist on the Molecular Sciences and Engineering Team at the Natick Soldier Research Development and Engineering Center, receives honors from Dr. Carole Tonello, 2013 Chair of the Non-thermal Processing Division, at the Institute of Food Technologists Annual Meeting this month.

Every year, more than 20,000 of the top food science and technology professionals from the most prominent organizations in the world convene in a hubbub of excitement at the Institute of Food Technologists Annual Meeting and Food Expo (IFT-AMFE) to discover the latest and greatest trends in science and technology.

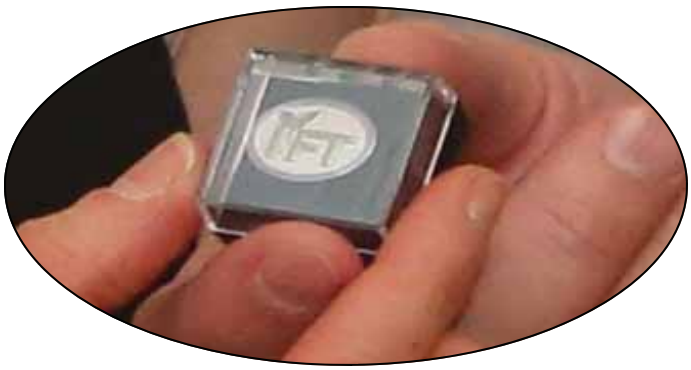
This year's IFT-AMFE in Chicago offered latest scientific developments, newest innovations, and hottest trends through its technical programming, pre-meeting educational Short Courses, and sampling the world's largest food expo. But it also offered something more.

At this year's IFT-AMFE, more than 1,400 professionals from across 54 countries were honored as the inaugural class of Certified Food Scientists. **Natick Soldier Research Development and Engineering Center (NSRDEC), Molecular Sciences and Engineering Team Physical Chemist Dr. Christopher Doona was one of them.**

This historic class of Certified Food Scientists received certificates from the International Food Science Certificate Commission (IFSCC) for their competence, proficiency, professional experience, education, and ethics. They were also recognized at a reception and entered IFT's Hall of Honor.

Certified Food Scientist designees are required to uphold a Professional Code of Ethics, such as performing duties with objectivity, diligence, and professional care; striving for continuous learning; and complying with laws, policies, and ethical and professional standards. The IFSCC oversees the governance and policy-making to ensure fairness and transparency.

"I'm honored by this recognition and to have been included in IFT's Hall of Honor with so many scientists I've always admired," said Doona. "It's amazing to realize just how much impact our research for the Warfighter has on the international science community."



NRC opp. leads to understanding composite materials & properties

Although **National Research Council (NRC) Associate Dr. Brent Volk** imagined pursuing a career in academia following receipt of his PhD from Texas A&M in 2010, a chance meeting with an Air Force scientist turned into an opportunity Dr. Volk never before considered.

"I met Dr. Jeffery Baur at a conference in 2010 and we had a really good discussion about the research we were hoping to do in the future," Dr. Volk explained. **Dr. Baur, NRC Adviser and research leader from the Air Force Research Laboratory Materials and Manufacturing Directorate's Structural Materials Division**, and Dr. Volk continued discussions following the conference and Dr. Baur suggested that an NRC project researching composite materials and properties could provide an opportunity for their continued collaboration. Dr. Volk arrived at AFRL to begin the project, *Three-Dimensional Modeling of Polymer Matrix Composites with Tailored Interfaces in Response to Fast Strain Rates and Extreme Temperature Gradients,* in October 2012.

During his NRC tenure, Volk developed a computational framework to investigate the effects of modifying the interfacial region in carbon fiber/polymer matrix composites when exposed to large temperature gradients. It is expected that this modeling framework will allow scientists to predict the response of current composite materials, and help in the design of new composite materials.

"The new composite materials could possibly include tailored nanoscale interfaces," Dr. Volk said. ***"For example, those with carbon nanotubes between the polymer matrix and the fiber tows. Dependent on the desired application, we're predicting that tailoring the interface will provide tunable thermal conductivity and subsequently promote or delay the onset of ablation without penalty in the mechanical properties."***

"In simple terms, we're developing a computational perspective on how composite materials will behave with different thermal gradients, and answering the question of whether the interface can help address various thermal challenges."

This research endeavor holds significance for Air Force applications, allowing scientists and engineers to improve the properties, strength and weight of materials, determine appropriate processing and manufacturing processes, and even predict how materials will behave during flight.

"There is also some applicability of this research in composite machining as well as in exploring the use of lasers for additive manufacturing of composites," Dr. Volk added. Dr. Volk's research was executed in a multi-scale manner where the representative volume element ranged from a single 7.5um fiber in a polymer matrix to a plain-weave composite. Through an integrated computational materials science and engineering (ICMSE) approach, the research led to an experiment in which a single carbon fiber was embedded in a polymer resin, and resistively and laser heated to observe the effects of the interface region. According to Dr. Volk, ongoing computational efforts are aimed at predicting the effects of modifying the thickness, conductivity, and absorption coefficients of the interface region.

"At the plain-weave scale, I leveraged an AFRL-developed textile code, Virtual Textile Morphology Suite (VTMS), to create realistic, virtual microstructure by simulating the boundary conditions and compaction method used during the processing of the composite," Dr. Volk added. ***"By developing a Python code, the tows created in VTMS are translated into Abaqus, a commercially available finite element software, in which the polymer matrix unit cell is formed around the tow geometries and the thermomechanical loading conditions are simulated. The sensitivity of the resulting effective material properties on the tow dimensions highlights the necessity to have accurate computational microstructures when performing the thermomechanical finite element analyses."***

"To better predict the final geometries of composite parts, I performed thermomechanical modeling to predict the residual stresses of the parts subjected to different cure cycles, thermomechanical boundary conditions, experimental calibrations and material models," he added.

Without the NRC Associateship Dr. Volk admitted that he'd probably never have experienced AFRL. Today, his research on scientific and technological challenges that are relevant to national interests is a source of tremendous patriotism and pride, he said. ***"I've had the benefit of working on multiple projects with collaborators from a broad range of backgrounds in support of a larger Integrated Product Team,"*** Dr. Volk explained. ***"And having a mentor like Dr. Baur was also extremely rewarding. I could tell he had a vested interest in my success and future, and wanted to help me position myself for whatever I chose to do next."***

Dr. Volk answered his "what next" question when he made the decision to become a government civilian with AFRL's Structural Materials Division in early 2014.

Drs. Jeffery Bauer, NRC Adviser, and Dr. Brent Volk, NRC Associate

Shear-Modification of Polymers: A Route to Better Processing

Debjani Roy[†] and C.M. Roland*
Naval Research Laboratory, Chemistry Division, Washington DC 20375-5342
[†]NRC post-doc *NRL Code 6126
(December 12, 2013)

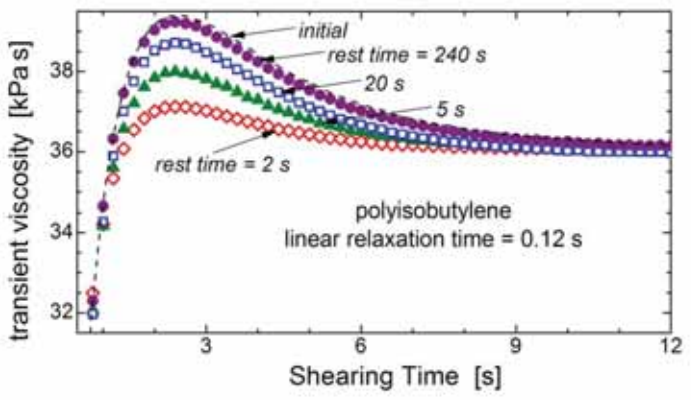
A major technical hurdle to implementing polymeric materials into commercial products is the requirement to process them efficiently and at low cost. This is a fundamental problem because the obvious solutions (e.g., lower molecular weight or use of plasticizers) reduce physical properties such as stiffness and strength. We have discovered a method to reduce both the viscosity and elasticity of polymers, which enables faster processing, with less energy expenditure, and (due to the lower elasticity) with improved dimensional control. Our method relies on physical changes to the material, which are thus reversible, resulting in no degradation of the ultimate performance.

The method involves steady-state shear flow of a polymer in order to reduce the concentration of chain entanglements. The unexpected finding is that the entanglements recover over a remarkably extended time period – more than an order of magnitude longer than predictions based on the linear viscoelastic response. That is, partially unentangled polymer chains have effectively lower mobility than fully entangled chains! The discovery that mechanical equilibrium does not correspond to structural equilibrium is without precedent in viscous liquids or polymers, and is not anticipated by any model of polymer dynamics.

The practical utility of the work is that the shear-modified material can be processed in a low viscosity, low elasticity state, with full entanglement recovery transpiring subsequent to mixing and forming operations. No new polymers or additives are required, and the method can be implemented on standard equipment. (For our laboratory studies we used instruments with well-defined flow fields, but the same effects can be achieved with conventional processing equipment.)

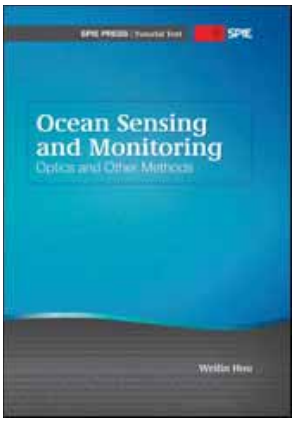
An additional result of our work is the resolution of three long-standing controversies in polymer science: (i) the disconnect between the rate of diffusion of polymer chains and the time required for an interface to coalesce when two layers are brought into contact; (ii) the peculiar rheology exhibited by polymers obtained by freeze-drying dilute solutions; and (iii) the deviation of the viscosity of ultra-high molecular weight polymers from extrapolations of the viscosity of lower molecular weights.

Slow recovery of maximum in viscosity, determined by concentration of chain entanglements.



References: D. Roy and C.M. Roland, *Macromolecules*, in press (2013).
D. Roy and C.M. Roland, *Gordon Research Conference on Polymers* (2013).

NRLSSC Press Release!



Professionals from related fields looking for insights and students needing an introduction to optical techniques for remote sensing of the ocean and ocean engineering will find answers in *Ocean Sensing and Monitoring: Optics and Other Methods,* a new book published by SPIE, the international society for optics and photonics.

Author **Dr. Weilin (Will) Hou, NRC Adviser and oceanographer with NRLSSC (Naval Research Laboratory at Stennis Space Center)**, starts with an overview of oceanography and presents the background, basic principles, and insights on the latest developments in the field needed to develop these systems. Optical remote sensing technologies provide the ability to monitor short- and long-term changes in coral reefs, deep-sea fisheries, and off-shore oilfields, and to supply real-time information about seismic activity, water conditions, and equipment functionality.

Because there are many specialized areas in oceanography, Hou takes a narrative approach and focuses on the science and reasons behind methods and approaches to ocean science. A significant portion of the book uses sketches and illustrations to convey ideas -- ideal for readers who are professionals from related fields or students exploring careers in remote sensing of the ocean or ocean engineering.

An overview of ocean research includes physical, chemical, biological, and geological oceanography as well as biogeochemistry. Basic optical properties of the ocean are discussed, followed by underwater and remote sensing topics including diver visibility; active underwater imaging and its comparison to sonar; ocean color remote sensing; and separate chapters on lidar, microwave, and infrared remote sensing techniques. The book concludes with a discussion of platforms and instrumentation, and integrated solutions and future needs in ocean sensing and monitoring.

"I believe, and I hope, we can work hard to explore new technologies to adapt different advances in the underwater environment to benefit society," said Hou in an SPIE Newsroom video interview.

Dr. Weilin Hou, NRC Adviser at NRLSSC, and fellow NRL SSC oceanographer Bob Arnone, have cochaired a conference on Ocean Sensing and Monitoring as part of the annual SPIE DSS Defense + Security symposium since 2008. The next conference: May 5-9, 2014 in Baltimore, Maryland.

The tutorial text was published by SPIE, the international society for optics and photonics, and is available in print or as an eBook.

Hurricane Research Division

Atlantic Oceanographic & Meteorological Laboratory

National Oceanic & Atmospheric Administration

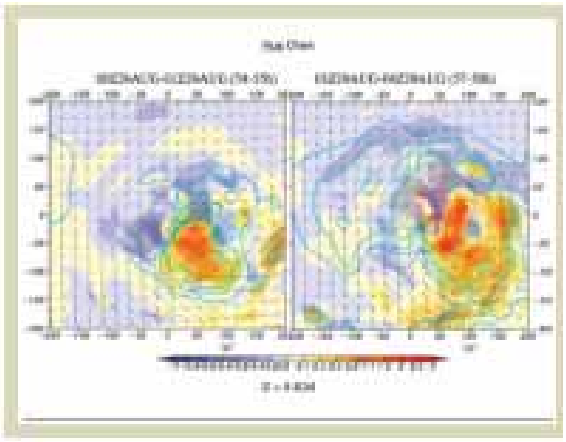
NOAA's Hurricane Research Division is a great microcosm and success story of the NRC Research Associateship Program. We feature below just four of the NRC Associates who were recently with NOAA's HRD.

Dr. Hua Chen just ended her time as a NRC Associate. **Dr. Jun Zhang was a recent NRC Associate**. Drs. Hua Chen and Jun Zhang presentations were featured in HRC 2014 February Science Meeting.

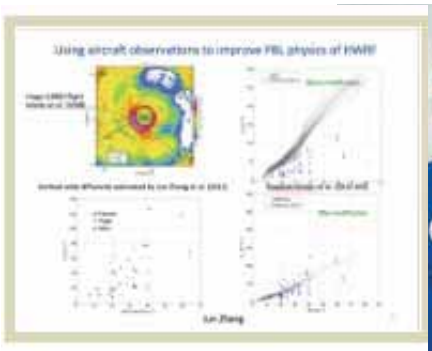
The presentations are available on the anonymous ftp site as a zip archive at:ftp://ftp.aoml.noaa.gov/hrd/pub/blog/meetings/2014/science/_SciMeet_20140213.zip, OR on http://oaahrd.wordpress.com/tag/hua-chen/#jp-carousel-8832

Dr. Hua Chen, UM/CIMAS & HRD – *Role of subsidence in RI of Hurricane Earl*

Dr. Jun Zhang, UM/CIMAS & HRD – *Using aircraft observations to improve HWRF physics*



H. Chen's presentation



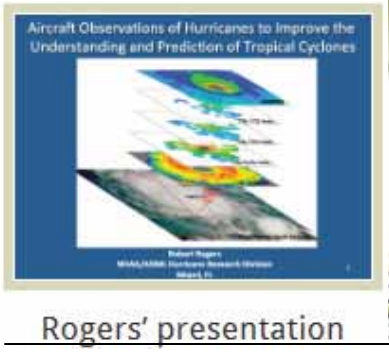
J. Zhang's presentation

Dr. Paul Reasor was a NRC Associate 2000-2002. Paul served as the director of the 2013 NOAA Hurricane Field Program.

Reasor presentation

Dr. Rob Rogers was a NRC Associate nearly 20 years ago. He and Dr. Sundararaman Gopalakrishnan (Gopal) gave invited presentations at the Hurricane WRF Tutorial held at the NOAA Center for Weather and Climate Prediction. This three-day event was organized by the Developmental Testbed Center (DTC) and by the NOAA Environmental Modeling Center (EMC).

The agenda for the tutorial is available at http://noaahrd.wordpress.com/tag/robert-f-rogers/



Rogers' presentation

All four participated in this year's **2013 Field Program**, and Hua participated in AOML's "open house", which is highlighted on her page.

Annual Postdoc Conference & Career Fair

"We have hired three postdocs we first met at the conference and they have made substantial contributions to our analytics business."

View more testimonials

Who?

A conference and career fair for current postdoctoral fellows working in Washington, D.C. area federal labs and universities, and for companies recruiting high-level S.T.E.M. (Science, Technology, Engineering and Mathematics) professionals.

What?

This event exposes area postdoctoral fellows in the S.T.E.M. fields to the many career options (e.g., government, private sector, entrepreneurship) that are available to them.

The career fair portion connects local job-seeking postdocs with companies seeking that level of talent.

When & Where?

Bethesda North Marriott / Montgomery County Conference Center
5701 Marinelli Road, Rockville, MD 20852

April 24, 2014

Time: TBA

Thursday April 24, 2014 is the date for the STEM Career Fair. The website has just opened for companies to register (http://postdocconference.org/) but will not open to postdoc participants until March 1, 2014.

Naval Research Laboratory-Stennis Space Center NRL SSC

Main web page: http://www7320.nrlssc.navy.mil/
Links to articles at: http://www7320.nrlssc.navy.mil/pubs.php
Descriptions of projects: http://www7320.nrlssc.navy.mil/projects.php

NAS/NRC (National Academy of Sciences/ National Research Council) Video Highlight

http://www.youtube.com/watch?v=IDbUL0L5mRw

Diaspora Collaboration Among Early-Career Researchers

Moderated by Kevin Finneran, Director of the National Research Council study, "The State of the Postdoctoral Experience in Scientists and Engineers Revisited"

Panelists:

- Lori Conlan, Director, Office of Postdoctoral Services, National Institutes of Health (NIH)
- Cathee Johnson Phillips, Executive Director, National Postdoctoral Association
- Gerrit Rößler, Program Director, German Academic International Network
- Vatsalya Vatsalya, Postdoctoral Visiting Fellow and Co-chair, Visiting Fellows Committee, NIH

Hosted by the U.S. National Academy of Sciences

NRC/RAP Website Highlight

http://sites.nationalacademies.org/pga/rap/

Explore Among 26 Programs — **Participating Agencies** — http://nrc58.nas.edu/RAPLab10/Opportunity/Programs.aspx

Name	Abbreviation	Reviews
Air Force Research Laboratory	AFRL	All
Armed Forces Radiobiology Research Institute	AFRRI	All
Army Aviation & Missile Research, Development, & Engr Center	AMRDEC	All
U.S. Army Medical Research & Materiel Command	AMRMC	All
U.S. Army Research Laboratory	ARL	All
Army Research Laboratory - U.S. Military Academy	ARL/USMA	All
U.S. Army Research Office	ARO	All
Chemical and Biological Defense Funded Laboratories	CBD	All
U.S. Army Edgewood Chemical Biological Center	ECBC	All
U.S. Environmental Protection Agency	EPA	All
EPA/Faculty Fellowship Program	EPA/FFP	All
FAA-Civil Aerospace Medical Institute	FAA/CAMI	All
Federal Highway Administration	FHWA	All
US Army Corps of Engineers Institute for Water Resources	IWR	All
Naval Marine Mammal Program	MMP	All
National Energy Technology Laboratory	NETL	All
Methane Hydrates Fellowship Program	NETL/MHFP	Feb., Aug.
National Institute of Standards and Technology	NIST	Feb., Aug.
Naval Medical Research Center/Naval Health Research	NMRC/NHRC	All
National Oceanic & Atmospheric Administration	NOAA	All
Naval Postgraduate School	NPS	All
Naval Research Laboratory	NRL	Feb., May, Aug.
U.S.Army Natick Soldier Research, Development & Engr Center	NSRDEC	All
U.S. Army Res, Dev & Eng Com/Armament Res, Dev & Eng Ct	RDEC/ARDEC	All
U.S. Army Research, Development & Engineering Command, NVESD	RDEC/NVESD	All
U.S. Army Criminal Investigation Laboratory	USACIL	All

2014 SCHEDULE

February Review

February 1	Application deadline
February 15	Deadline for supporting documents (transcripts/letter of recommendation)
March 18	Review results finalized
March 25	Review results available to applicants

August Review

August 1	Application deadline
August 15	Deadline for supporting documents (transcripts/letter of recommendation)
Sept 19	Review results finalized
Sept 26	Review results available to applicants

May Review

May 1	Application deadline
May 15	Deadline for supporting documents (transcripts/letter of recommendation)
June 20	Review results finalized
June 27	Review results available to applicants

November Review

Nov 1	Application deadline
Nov 15	Deadline for supporting documents (transcripts/letter of recommendation)
Jan 5, 2015	Review results finalized
Jan 12, 2015	Review results available to applicants

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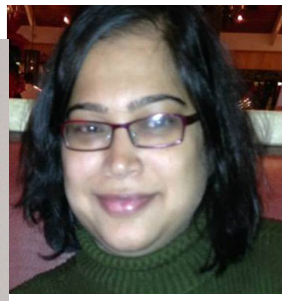
Or...



Dr. Debjani Roy
NRC Associate
NRL Chemistry Division

Shear-Modification of Polymers: A Route to Better Processing

see page 16

Dr. C.M. Roland
NRC Adviser
NRL Chemistry Division