



## National American Chemical Society Meeting

Louisiana Tech faculty and students demonstrated their leadership in nanotechnology with visible impact on the progress of this discipline at the ACS Meeting in Philadelphia. This leadership was recognized through our chairing of the international symposium: "Nanoassembly: from Fundamental to Ap-



*LaTech's speakers in Philadelphia L-R:  
 M. Agarwal, P. Derosa, T. Dobbins, Y. Lvov, S. Balkundi, Z. Zheng*

plications." The nanoassembly symposium was a part of the 236<sup>th</sup> National Meeting of The American Chemical Society which was held at the Philadelphia Sheraton hotel, August 17-22. Louisiana Tech University's Yuri Lvov and MIT's Michael Rubner organized and led this successful symposium which attracted over two hundred scientists from around the world. Representing Louisiana Tech University, Prof. Tabbetha Dobbins delivered an invited talk on non-aqueous nanoassembly for hydrogen storage materials, Prof. Pedro Derosa an invited talk on multiscale modeling of conductive polymers, Research Prof. Mangilal Agarwal on conductive paper, and Prof. Yuri Lvov on clay nanotubes for corrosion protection. Graduate students representing the Institute for Micromanufacturing (IfM) and Bio-

medical Engineering, including Zhiguo Zheng, Shantanu Balkundi (shown below), presented 7 poster reports on nanostructured materials. The American Chemical Society (ACS) meeting had a large number of symposiums attracting to Philadelphia twelve thousand researchers from around the world. ACS national meetings are among the largest science meetings in our country, presenting a great forum where chemists discuss and compare their results, collaborating on new ideas, and inspiration for innovation. The IfM team succeeded in positioning Louisiana Tech University to be among the national leaders in nanotechnology with a total of eleven papers presented on nanomaterials.

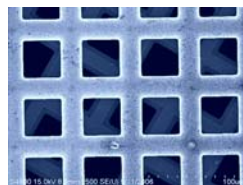
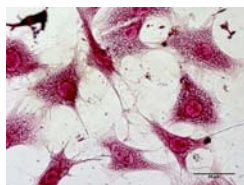
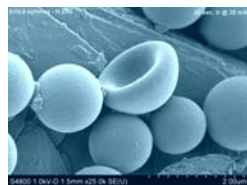
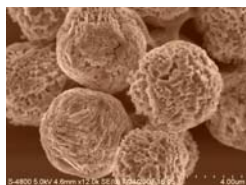
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### Special points of interest:

- Nanotechnology
- Biotechnology
- Biomedical Nanotechnology
- Environmental Technology
- Information Technology

## IfM Faculty and Staff SEM and TEM Examples



**Newsletter Editor**  
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 Comments are welcomed!



## LBRN Work-in-Progress Seminar Series

A Louisiana Biomedical Research Network (LBRN) work in progress seminar was held August 4, 2008 where IfM and BME faculty participated with other universities in Louisiana via an access grid. The following abstracts represent talks by Dr. Andrei Paun and Dr. Mark DeCoster.



**Dr. Andrei Paun**

Dr. Paun presented "Discrete nondeterministic Modeling of Cellular pathways".

Computer modeling of molecular signal cascades can provide useful insight into the underlying complexities of biological systems. We provide a refined approach of the discrete modeling of protein interactions within the environment of a single cell. The technique we offer utilizes the Membrane Systems paradigm which, due to its hierarchical structure, lends itself readily to mimic the behavior of

cells. Since our approach is non-deterministic and discrete, it provides interesting contrast to the standard deterministic ordinary differential equations techniques. We argue that our approach may outperform ordinary differential equations when modeling systems with relatively low numbers of molecules - a frequent occurrence in cellular signal cascades.

Refinements over our previous modeling efforts include the addition of nondeterminism for handling reaction competition over limited reactants, increased efficiency in the storing and sorting of reaction waiting times, and modifications of the model reactions. Results of our discrete simulation of the type I and type II Fas-mediated apoptotic signal cascade are illustrated and compared with two approaches: one based on ordinary differential equations and another based on the well-known Gillespie's algorithm.

Dr. DeCoster presented "Cellular Morphological and Biochemical Changes During Apoptosis *in vitro*: Links to Modeling".

Apoptosis is a form of controlled cell death and is a major cellular process now providing "rules of biology". In the brain, while apoptosis is a normal part of clearing unused neurons during development, inappropriate apoptosis may contribute to neurodegenerative diseases such as Alzheimer's and Parkinson's disease. On the other hand, failure to obey normal apoptotic signals, such as in cancer, may result in

unchecked cell growth, leading to the formation of tumors. Thus, apoptosis stands central as a dynamic cellular process contributing to the overall equation determining cell fate. Using image analysis of digital microscopy images as well as biochemical indicators, here we present strategies for measuring apoptosis in cells *in vitro*.

These include measuring changes in cell nuclear size and shape after defined apoptotic stimuli by using DNA stains (DAPI), and measuring overall cell morphology changes and cell growth areas of living cells undergoing apoptosis (or not) using the vital dye calcein. We have found that quantification of cell growth areas (as opposed to cell numbers), may also be a key factor in understanding the timeline of tumor cell growth, or shrinkage during drug treatment. Specific biochemical markers for key steps in apoptosis include caspase-3 measurements, which we have carried out previously using microscopy and are now scaling up to make use of high through-put techniques. One aim of the current project is to link these assessments to modeling methods so that neuroprotective strategies and anti-cancer treatments can be more effectively developed. Finally, in future studies we plan to utilize nanotechnology tools for defining cell environments through patterning, to address the issue of how local cellular networks may affect individual cell fate via, for example, paracrine factors or physical contact. Since apoptosis can involve many steps before final cell destruction, having a large array of assessment tools is likely key to understanding (and modeling) the overall process.



**Dr. Mark DeCoster**



*We dedicate this issue of the Infinitesimal to the memory of our friend and co-worker, Scott Williams. Scott was associated with IfM for 12 years and a permanent employee for the past 10 years. Scott lost his battle with leukemia on August 6, 2008.*

*James Scott Williams  
May 10, 1957 - August 6, 2008*



# University of Western Hungary Honors Dr. George Grozdits



and Ph.D. from Virginia Tech, Blacksburg, Virginia. Following the revolution, the Hungarian Forest Engineering College reinstated their emigrants and granted each the Diploma of Forest Engineering.

Grozdits is a wood technologist/lignocellulose material scientist – involved in studying woody tissue formation, ultrastructure of the fabulous cellulosic fibers, and surface properties affecting wood composite formation. All

of these areas ultimately culminated in the use of nano technology.

Under the leadership of President Daniel D. Reneau,

the Louisiana Tech University BioEngineering/Nanotechnology area was created. Dr. Yuri Lvov's innovation and foresight to move LbL nanocoating into the cellulosic fiber industry for better smart paper, and Associate Director Dr. Mark Gibson and School of Forestry's support contributed to Grozdits receiving the 37<sup>th</sup> Honorary Doctor Degree from the 273 year old university. Grozdits would like to extend his appreciation to Dr.'s Gibson, Lvov, other IfM colleagues, and Louisiana Tech University's College of Engineering and Science as a whole for the opportunity to be able to work and create at Louisiana Tech.

Dr. George Grozdits, Research Professor at Louisiana Tech University's School of Forestry, working with the LbL Group (Layer-by-Layer Molecular Selfassembly of improving paper production through nanocoating) of Dr. Yuri Lvov at IfM was awarded the *Doctor Nonoris Causa* (Honorary University Doctor) by the Faculty Senate of the University of Western Hungary, Sopron, Hungary.

The school was established in 1735 to support the mining industry, namely to produce timber and surveyors for underground mining. The University of West Hungary was established January 1, 2000 by joining centuries old independent pedagogue, agricultural, forestry, geoinformatic and agricultural economic colleges. It prides itself as a "green university".

Grozdits has been associated with the University system of Hungary for the past 54 years, through Forestry and Wood Engineering.



*Dr. George Grozdits*

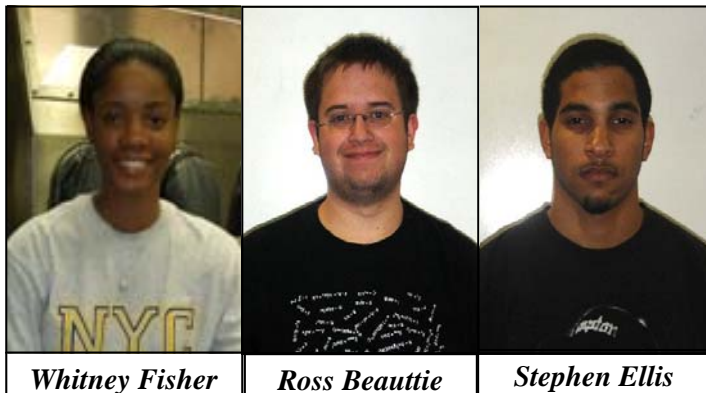
Emigrating to Canada Dr. Grozdits graduated with a BS in Forestry degree from the University of British Columbia in 1959. He later obtained an M.Sc.



# The JFAP Faculty Continue To Provide Opportunities For Undergraduate Summer Research

After carrying out the JFAP summer outreach program for three years in a row, the JFAP Faculty, Drs. Derosa and Dobbins continued this year with the tradition by giving 5 undergraduate students from LA Tech and Grambling an opportunity for a summer research experience. JFAP refers to the Joint Faculty position between Louisiana Tech and Grambling State University that Dr. Dobbins and Derosa work under, and since the implementation of the JFAP summer program in 2005, the JFAP faculty involved students from Grambling State University and Louisiana Tech University in research activities at the IfM.

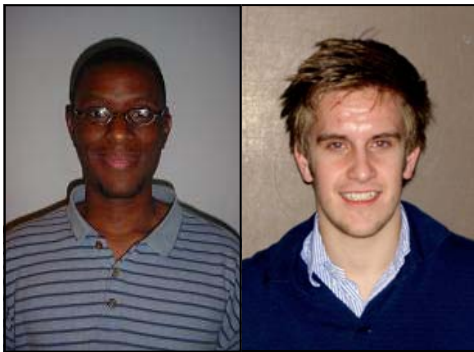
This summer 2008 Drs Dobbins and Derosa found new venues to provide opportunities to undergraduate students to conduct first class research. Whitney Fisher, a chemical Engineering major at LA Tech, worked under the guidance of Dr. Dobbins while conducting research at the Louisiana State University's Center for Advanced Microstructures and Devices (CAMD). On the other hand Ross Beattie, physics major at LA Tech and Stephen Ellis Biology major at Grambling work with Dr. Derosa at IfM. Whitney's activities were supported by Dr. Dobbins' NSF funds, while Ross and Stephen were supported out of Dr. Derosa's Air Force Minority Leaders program's funds.



Whitney Fisher

Ross Beattie

Stephen Ellis



Richard Chevious

Tyler Michalak

In addition to the three students mentioned above, Richard Chevious (Physics) and Tyler Michalak (nanosystems engineering) were supported by Drs Dobbins and Derosa respectively as part of their Air Force supported Minority Leaders Program, to spend their summer in a co-supervised internship with collaborators of the JFAP Faculty. Richard's activities were based at Texas A & M hosted by Dr. Hung-Jue Sue while Tyler work at University of Massachusetts in Amherst with Dr. David Ford. These students' activities were aimed at setting up and strengthen the collaboration between LA Tech and the host Universities.

It is commendable that despite the uncertainty in funds, for four years in a row the JFAP faculty successfully involved a large number of undergraduate students (23 in four years) in meaningful research activities helping them become more competitive towards graduate school, advancing at the same time the forefront of science.

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**Linking Epon Polymers With Carbon Nanotubes**  
 Stephen Ellis<sup>2</sup>, Ross Beattie<sup>1</sup>, Steven Baker<sup>1</sup> and Pedro Derosa<sup>1,2</sup>  
<sup>1</sup>Louisiana Tech University, Ruston, LA 71272  
<sup>2</sup>Grambling State University, Grambling, LA 71245

**Abstract**  
 The conduction properties of EPOH802, a known insulator, may be dramatically altered by carbon nanotubes (CNT) in nanocomposites. This work conducted by undergraduate students' Stephen Ellis and Ross Beattie, is a first step towards understanding the effect that CNT have on the conductive properties of EPOH802. The relative stability of different isomers of the monomer is studied. In addition, a CNT-EPON monomer complex is simulated with Density Functional theory as implemented in Gaussian 03, to determine the geometry of the link, in this case, a section of CNT, cleaved perpendicular to the cross section, is considered in order to minimize the number of atoms in the simulation. The effect of considering just a section of CNT vs an entire circumference is analyzed.

The figure shows a set of Molecular orbitals superimposed for both a full CNT and a section with EPOH in out-of-phase conformation. The MOs are distributed in a range of energies roughly between -6.4eV and -6.7eV that is the region where MOs from EPOH are observed. The HOMO for both structures is about -6.4eV, which corresponds to the HOMO for CNT. The MOs associated with EPOH lie low in energy and thus a large barrier is expected for conduction. A similar picture is observed for uncoupled orbitals. The HOMO for EPOH is found to be -6.12eV while the LUMO is 0.55eV. The large gap is expected for an insulator.

Calculations conducted here show different attachments between EPOH and CNT. The pictures above show Top, meta-meta, para-meta, and para-meta conformation. Bottom: out-of-phase.

A H atom is detached from the molecule that now bonds covalently to the CNT. This type of link is expected to cause a much larger effect on the properties of CNT than the first case.

No particular attachment has clearly emerged as the most probable and further studies are being conducted to understand this.

**Conclusions**  
 A few important ground breaking results were obtained in this work.  
 - The meta-meta conformation is more than 1xT more stable than all other isomers and it is expected to be the preferred conformation in a crosslink.  
 - The chemical characteristics of the interaction between EPOH and CNT are mostly preserved when a section of CNT is used from allowing to reduce the number of atoms to simulate. By duplicating the contact geometry on the other side of EPOH, a two contact device can be generated for modeling.

Fall 2008 Nano Seminars

- October 28, Tuesday, 2 p.m. Proyag Datta, LSU, Baton Rouge (CAMD), Modular Microfluidic Systems - A Research & Development Platform for Biological and Chemical Applications
- November 11, Tuesday, 2 p.m. Subhra Nag and David Mills (IfM/Biology) "Fibrochondrocyte Response on Growth Factor Treated PCL Electrospun Scaffolds"
- December 2, Tuesday, Stefano Loporatti, Roberto Cingolani, National Institute of Nanotechnology, Lecce, Italy, "Engineering Micro/Nano Environment via Layer-by-Layer Composite Films for Breast Cancer Cells' Controlled Growth"

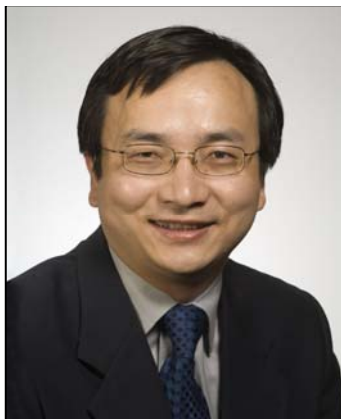


## IfM Welcomes New Faculty



**Dr. Niel Crews**

Dr. Niel D. Crews, Assistant Professor of Mechanical Engineering, received his Ph.D. in Mechanical Engineering from the University of Utah in 2008. His research is in the area of microfluidic thermal systems and their use within medical diagnostic instrumentation. His work examines device design and fabrication, thermal and bio-chemical interactions, and reaction kinetics. He received his M.S. in Mechanical Engineering from the University of South Carolina, and his B.A. in Physics from Erskine College.



**Dr. Shengnian Wang**

Dr. Shengnian Wang, Assistant Professor of Chemical Engineering, received his Ph.D. in Chemical Engineering from the Ohio State University in 2006. Dr. Wang worked in NSF Nanoscale Science and Engineering Center for Affordable Nanoengineering of Polymeric Biomedical Devices (CANPBD). His research interests include polymer micro/nanofabrication, micro/nanofluidics, and exploring their applications in medical diagnostics and clinical therapeutics. Dr. Wang received his B.E. from Zhejiang University in Chemical Engineering, and M.S. from Dalian Institute of Chemical Physics, Chinese Academy of Sciences in Chemical Engineering.



**Dr. Leland Weiss**

Dr. Leland Weiss received his Ph.D. in Mechanical Engineering from Washington State University in 2008, specializing in thermodynamic processes and heat transfer on the micro-scale. Leland has also worked in industry for several years at Caterpillar, Inc.'s Engine Research facility. Current research interests include the capture and re-use of waste energy for the purpose of energy conservation and system efficiency improvements. These efforts are focused on the use of low-grade waste heat as an untapped energy source.

## Student Accolades

Congratulations to Mr. Raja Mannam for receiving The Electrochemical Society (ECS) Electrodeposition Student Award. This award is one of three travel grants given in the Electrodeposition section each year to graduate students who are selected to present their work at ECS international conferences. The award will be acknowledged at the Electrodeposition Business Luncheon of the 214<sup>th</sup> Joint International ECS Meeting in Honolulu, Hawaii, where Raja will present a talk on "Novel Thermoelectric Cooling of Magnetic Sensors," during the conference to be held October 12-17, 2008.

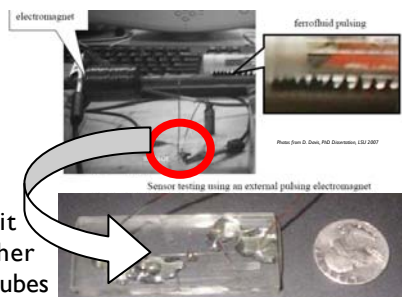
Raja is a second year Ph.D student working under the guidance of Dr. Despina Davis. His current research involves investigating the thermoelectric properties of Bismuth Telluride (BiTe) nanowires, Thermoelectric cooling of GMR nanowires, a Louisiana Tech University patented project under Dr. Davis.



**Raja Mannam**

As a result of this conference and presentation, Head of the Electrochemical Research Division of IBM in New York, Dr. Lubomyr T. Romankiw has expressed interest in working with Dr. Davis and Raja on this current project. Congratulations to Dr. Davis, Raja and all participants of this project.

One of the invited talks included a successful collaboration between LSU (R. Mishra, Y. Li, D. Young, W. Wang), LaTech (D. Davis), MIT (J. Albrecht, J. Jensen) and Northeastern University (R. Daneshvar, E. J. Podlaha). The title of this invited talk was Electrodeposited Co-alloy GMR Multilayers for Nanoparticle Detection in a Microchannel. These microfluidic sensors use GMR to detect magnetic nanoparticles for biological applications and they are of interest for high sensitivity screening of protein and DNA, provide a vehicle for the placement, detection, and study of biomolecular interactions, and magnetically assist separations. In their study different electrodeposited GMR multilayered elements are considered for the detection of diluted ferrofluids: *i.* serpentine thin films, *ii.* nanowire and *iii.* nanotube arrays. Conditions to electrodeposit preferentially either nanowires or nanotubes were presented.



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## Vision and Mission

The vision of the IfM is to be a world-class resource for the realization of commercially-viable micro- and nano-systems, contributing to the economic infrastructure of Louisiana and the nation and benefiting humanity as a whole.

The mission of the IfM is:

- To research and develop novel micro and nanosystems for biomedical, biological, environmental, chemical, information technology, and other applications
- To generate and harness commercially viable intellectual property
- To partner with industry, government, and academia in economic development

- To transfer new technology and provide technical training to industry and government
- To develop curricula and educate students in micro/nano scale technologies and systems

The IfM offers a wide range of microtechnology capabilities for the realization of micro electro mechanical systems (MEMS), as well as a complementary array of nanotechnology capabilities for MEMS and other applications.

**Nanotechnology, Biotechnology, Biomedical Nanotechnology, Environmental Technology, and Information Technology** constitute the five major research and development thrust areas and centers of excellence of the IfM.

Examples of projects include:

BioMEMS efforts aimed at the development of select commercially viable micro and nanosystems for biomedical and biological applications; EnviroMEMS efforts aimed at the development of select commercially viable micro and nanosystems for environmental and chemical applications; Nanotechnology efforts directed at the development of select commercially viable nanotechnologies for BioMEMS, EnviroMEMS, and other applications; Information technology efforts are directly supportive of the State of Louisiana IT Initiative and current efforts include projects for the realization of enabling micro/nanotechnologies for information sensing, storage and processing.



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