diSCovering RESEARCH
A Quarterly Publication of the South Carolina EPSCoR/IDeA State Office
Fall 2008

A Look Inside:

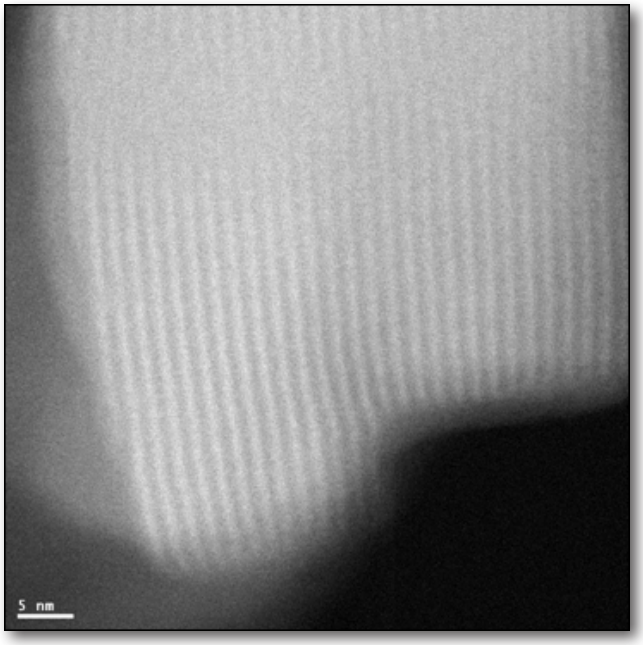
Claflin Hires Microbiologist with NSF Grant

As part of the NSF EPSCoR Research Infrastructure Improvement project (EPS-0447660), Claflin University has recently hired Dr. Samina Noorali Hassanali as an Assistant Professor in the Department of Biology. Trained as an immunologist, Dr. Hassanali is transitioning from a research faculty position to a tenure-track position and will be training in stem cell technology under the mentorship of Dr. Omar Bagasra. Dr. Hassanali earned her PhD in Microbiology from the University of Karachi in Pakistan and completed a post-doctoral fellowship at the Cancer Research Center in Vancouver, British Columbia.

Currently, Dr. Hassanali is the lead on a project entitled "Bioengineering of the Tooth Structure and Vasculogenesis from Dental Pulp." The goal of this project is to use dental pulp as a cell source to develop techniques to regenerate dental tissue. The project will utilize a modern controlled nutritional system manufactured by RP Technology for bone development.

Researchers Begin DEPSCoR Project

Researchers at the University of South Carolina were recently awarded a $500,000 Department of Defense EPSCoR (DEPSCoR) award (FA9550-08-1-0377) for work on the subject of polymer nanocomposite dielectrics. Dr. Hans-Conrad zur Loye, a Professor in the Department of Chemistry and Biochemistry, and Dr. Harry Ploehn, a Professor in the Department of Chemical Engineering, are working together to develop a revolutionary class of lightweight, high-energy density capacitors. These capacitors will be superior to commercially available super capacitors in applications that require high-voltage, pulse power. Pulse power is important in technologies that require very short bursts of large amounts of energy to operate. In the coming years, the military will require up to a twenty-fold increase in capacitor energy density for special operations forces, propulsion systems, and so-called "directed energy weapons." This new class of capacitors is also critical to reducing weight and size of power storage systems used in aircraft, spacecraft and other transportation systems.



STEM image of $CaTi(C_6H_5PO_3)_3$, a new layered mixed metal phosphonate that is used to prepare the nanocomposites with dramatically increased dielectric constants, a necessary step to achieve high power density, and a plot of dielectric constant as a function of loading, which illustrates the up to 10 fold increase in the dielectric constant of the composite. *(Image Courtesy: Dr. Hans-Conrad zur Loye)*

New CoEE in Advanced Tissue Biofabrication Announced

Clemson University, the Medical University of South Carolina, and the University of South Carolina will all be participants in a recently announced South Carolina Center of Economic Excellence (CoEE). The purpose of the CoEE in Advanced Tissue Biofabrication will be to develop processes for the production of complex tissues and organs using a technique called "bioprinting" or three-dimensional layering of individual cells. CoEE researchers will attempt to create a vascular supply which would allow for more complex tissues to be made than are currently feasible. The CoEE program establishes centers at the universities in research areas and recruits world-class scientists to advance South Carolina's economy. Each CoEE is awarded up to $5 million in state lottery funds, which must be matched on a dollar-for-dollar basis with non-state funds.

The CoEE in Advanced Tissue Biofabrication is largely due to the work of Dr. Roger Markwald, who is the Chair of the Department of Cell Biology and Anatomy at MUSC and an Institutional Principal Investigator for South Carolina's INBRE program. Recently, Dr. Markwald was awarded a Competitive Centers Development award from SC EPSCoR/IDeA to further develop the field of advanced tissue biofabrication and to conduct a symposium to establish statewide collaborations. Through EPSCoR/IDeA, CoEE, and other collaborative programs, researchers in South Carolina are making great strides in the field of bioengineering.

SC EPSCoR/IDeA Request for Images

SC EPSCoR/IDeA is constantly working to improve its library of scientific images available for publicity, advocacy and other purposes. If you have scientific images highlighting your EPSCoR/IDeA-related research, please email them to lee.snelgrove@scra.org with a short caption in language understood by a non-scientist. Please also include any requirements for citation that may need to accompany the image. We are interested in images related to: advanced materials/ nanoscience; environmental science/ecology; public health; medical/biotechnology; structural, chemical, and cellular biology; wireless communications; and image processing.

Citation Requirements

EPSCoR Investigators:
In accordance with NSF guidelines for publications, all investigators awarded funding through NSF/ EPSCoR will be responsible for assuring that an acknowledgment of NSF/EPSCoR support is made in any publication (including Internet pages) of any material based on or developed under this project, in the following terms:

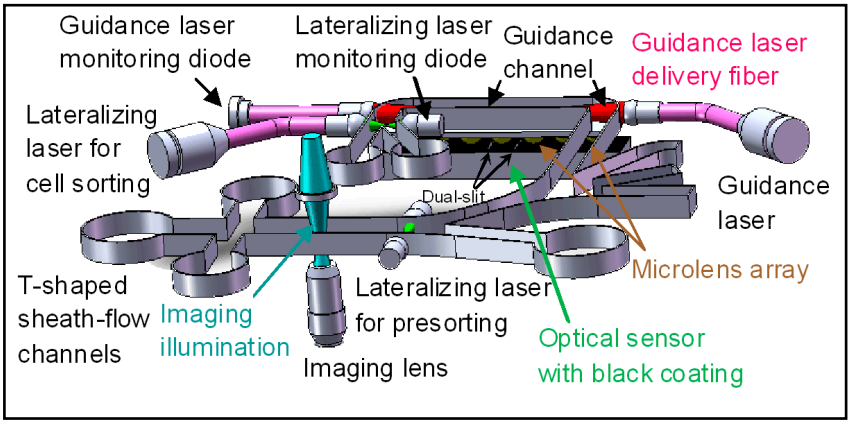
*"This material is based upon work supported by the National Science Foundation/EPSCoR under **Grant Number EPS-0447660**. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation."*

INBRE Investigators:
The INBRE grant should be cited in all abstracts, presentations, posters and publications where INBRE funds (start-up, salary, equipment, supplies, etc.) have contributed to support of the work. The publication's (presentation's, etc.) acknowledgement of NCRR funding and disclaimer should read as follows:

*"This publication (presentation, etc.) was made possible in part by **NIH Grant Number P20 RR-016461** from the National Center for Research Resources. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the NIH."*

Clemson Develops Advanced Techniques for Cell Sorting

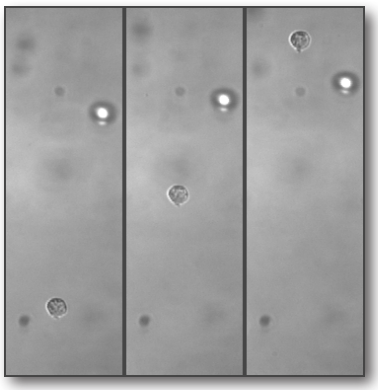
Dr. Bruce Z. Gao and a team of researchers at Clemson University have recently developed new techniques for cell sorting as part of the South Carolina INBRE program (NIH P20 RR16461). Cell sorting is important in cell biology, immunology, stem cells, and cancer research by allowing scientists to purify and cultivate specific types or mutations of cells.



Schematic of the laser guidance-based microfluidics mediated cell sorter
(Image Courtesy: Dr. Bruce Gao)

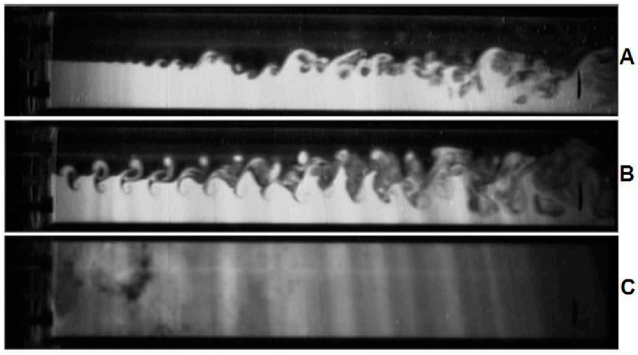
Currently, the state-of-the-art in cell sorting requires researchers to use fluorescence to label cells prior to sorting. Use of fluorescence can be extremely limiting in projects that require labels that are unavailable or when their application is clinically restricted. Some other methods for label-free sorting have been developed; however, they are not useful in detecting minute changes in phenotype or genotype. Dr. Gao and his team have discovered that by measuring the speed of a moving cell guided by a laser microbeam, different cell types can be detected at the precise level of single gene modification without any labeling process.

Cells that are placed in the focal region of a weakly focused laser beam will encounter a force that will move the cell toward the center of the beam and will propel them along the beam. Cells with differing properties (size, shape, composition, and reflectivity) will demonstrate differing speeds as they move along the beam, and the speeds can then be measured to sort the varied cells. This has proven useful in cases where it is necessary to identify similar cells that may only have a genetic modification and in cases where cancer cells are in various stages of progression. Currently, Dr. Gao's research group is combining this laser-guidance technique with microfluidics to develop a prototypic cell-sorting device that can be used by researchers and clinicians.



Three frames from a video depicting cell guidance
(Courtesy: Dr. Bruce Gao)
Available online at www.scepscoridea.org

Graceflow Technology Develops Novel Fluid Mixing Process



Graceflow fast pipeline mixing technology: (A) unforced mixing in a pipe; (B) mixing under conventional forcing; (C) rapid mixing under our new forcing mechanism. *(Image Courtesy: Dr. Hong Jiang)*

Graceflow Technology, a small business based in Irmo, South Carolina, has developed a new process for mixing fluids efficiently and rapidly. There are many industrial processes that require fast fluid-mixing technology, such as cell culture and fermentation, solid oxide fuel cell manufacturing, biomass combustion, heating ventilation and air conditioning, and polymer processing. It is estimated that the U.S. chemical processing industries spend approximately $10 billion per year due to the drawbacks of current fluid mixing technology including slow heat exchange, required persistent cleaning, and safety concerns. Graceflow's novel technology will enhance efficiency to improve process safety and product quality, increase product yield, save energy and greatly reduce costs. The technology also has the potential to decrease unburned fuel emissions into the environment and enhance biological wastewater treatment systems.

Graceflow's novel mixing method will allow for the mixing of two fluids at varying Reynold's numbers. The Reynold's number is a ratio of the fluid's inertial forces to its viscous forces in fluid mechanics. Fluids that have a high Reynold's number are often thinner and have a higher likelihood of turbulent flow. Fluids with a low Reynold's number often flow smoothly and constantly and when mixed often require extensive cleaning using current mixing methods.

Graceflow's business model resulted from a collaboration between Dr. Hong Jiang and Dr. Guiren Wang. Dr. Wang is an EPSCoR/IDeA new hire (EPS-0447660) and an Assistant Professor in the Department of Mechanical Engineering at the University of South Carolina. Graceflow has recently submitted a Phase I to the National Science Foundation entitled "A Novel Rapid Mixing Process and Mixer in Continuous Operation." They have been awarded patents by both the United States and Germany, and are currently preparing two new patent applications.

SBIR Phase-0 By the Numbers

10 to 1
The return on investment of the EPSCoR/IDeA Phase-0 Program to date

31
Number of Phase-0 proposals supported through a joint partnership between SC EPSCoR/IDeA and the SC Department of Commerce to stimulate commercialization activities of small, high-tech businesses

150
Number of proposed new jobs that will be created by the expansion of Innegrity, LLC, an Upstate-based advanced fibers manufacturing firm that has been the recipient of multiple Phase-0 awards

$2,500,000
Phase I and Phase II awards won by Phase-0 supported companies since the program's inception in 2005

Researcher Testifies on Importance of Nanoenvironmental Research

In April, Assistant Professor Lee Ferguson of the Department of Chemistry and Biochemistry at the University of South Carolina made a case before the U.S. Senate Subcommittee on Science, Technology and Innovation about the importance of continuing support of research into the effects of nanotechnology on the environment. Dr. Ferguson's invited testimony recommended that the Subcommittee reauthorize the National Nanotechnology Initiative and increase the funding for nanoenvironmental research to 10% of the Initiative's budget. The effects of nanotechnology on the environment are difficult to measure with current technology and nanomaterials may be quite unpredictable from other "pollutants-of-concern", such as heavy metals, in the way that they spread through the ecosystem. Dr. Ferguson explained that "there are indications of risks associated with exposure of humans and ecosystems to nanomaterials. These risks include direct toxicity and uptake of nanomaterials into biological tissues." To address these risks, Dr. Ferguson outlined specific areas of research that require attention, including detection and characterization of nanomaterials, standardized testing methods, the routes of human and ecological exposure, and the "mechanisms by which nanomaterials act."

USC NanoCenter
at THE UNIVERSITY OF SOUTH CAROLINA

Dr. Ferguson, hired as part of the 2000 NSF EPSCoR Cooperative Agreement (EPS-9983444), is a member of the nanoenvironmental research group at the NanoCenter at USC, which was initiated by the same award. Nanoenvironmental research has become a major focus area for the center, as it was recently awarded a South Carolina Center of Economic Excellence for Nanoenvironmental Research and Risk Assessment. Through nanoenvironmental research, scientists can take steps to assess the risks of nanotechnology as it's being developed, rather than waiting until side effects caused by new technologies take hold and negatively impact humans or the environment.

Do you have significant research achievements and opportunities? Send ideas to be considered for use in upcoming newsletters to the editor at lee.snelgrove@scra.org.

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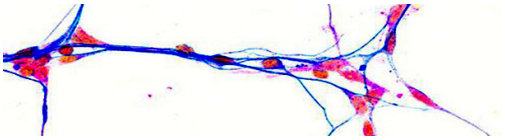

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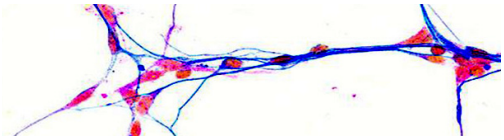

Congratulations

The South Carolina EPSCoR/IDeA Office would like to express congratulations to the following faculty members:

Dr. Esin Gulari – Dr. Gulari, Dean of the College of Engineering and Science at Clemson University, was confirmed by the U.S. Senate to serve on the National Science Board. Dr. Gulari represents the first member to serve on the National Science Board from an institution in South Carolina and the first from an EPSCoR or IDeA state.

Dr. Terry Tritt – Dr. Tritt, Principal Investigator of a DOE EPSCoR Implementation Grant at Clemson University, was recently awarded the 2008 South Carolina Academy of Science Governor's Award for Research, a 2008 Clemson University Alumni Award for Research Excellence, and a 2008 College of Engineering and Science Faculty Achievement Award for the Sciences.

Dr. Victoria Turgeon – Dr. Turgeon, an INBRE Target Faculty at Furman University, was awarded over $25,000 from the SC Spinal Research Fund for her project entitled "Myelin Regulation in the Spinal Cord Following PAR-1 Activation." The award will allow for the purchase equipment and supplies, and will support undergraduate student research.

Upcoming EPSCoR/IDeA Sponsored Events

2009 Ernest E. Just Symposium
February 27, 2009
Charleston, South Carolina

Symposium for Young Neuroscientists and Professors of the Southeast (SYNAPSE) 2009: *Human Disease Research in the 21st Century*
March 28, 2009
Charleston, South Carolina

South Carolina Statewide Science, Technology, and Health Conference & Annual Meeting of the South Carolina Academy of Science
April 14-16, 2009
Columbia, South Carolina

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Columbia, SC 29201