HiDEC Goes Nano in 2012!

Installation of the JOEL 5500FS E-beam lithography tool acquired through the NSF EPSCoR GREEN Center under the leadership of Dr. Vasundara Varadan began at HiDEC on March 1st, 2012. HiDEC staff has been hard at work setting up the facility needs for this tool, which includes a new glass wall for added security, UV blocking and noise reduction, a 16kVA uninterruptable power supply, and electrical and plumbing changes in the facility.

At the conclusion of the eight-week installation process, the new system will provide HiDEC its first opportunity to perform pattern creation on a sub-micron scale (10nm feature size capability) on a working area of about 75mm x 75mm.

The new E-beam bay will have a complement of accessories, including a high-powered microscope, a solvent wet bench, a low-powered plasma asher, a spin coater, and an electron-beam evaporator. These tools will allow researchers to conduct all processing steps related to the E-beam lithography system in one area.

In addition to this new capability, HiDEC staff is working on hydrogen and methanol-powered fuel cells using low-temperature co-fired ceramic (LTCC) technology. Research to enhance the performance of these cells is being performed through the use of nanostructured platinum and Nafion nanofiber composite membranes (in collaboration with Dr. J. Chen and Dr. R. Tian of the UAF Chemistry Department).

In another effort, nanorods are being grown in the HiDEC Synthesis Laboratory for use in ultra-violet detectors and solar cell applications. The sol-gel technique is being applied to grow nanostructured self-cleaning surfaces for photovoltaic panel applications and high-voltage passivation materials for power electronics module encapsulation. Other research efforts that are currently underway at the HiDEC facility include the design and fabrication of power modules, micro and nano-system integration, and various applications of LTCC substrates.

The High Density Electronics Center (HiDEC) is an open research facility that provides training and access to faculty and students as well as external industrial clients, allowing them to leverage the tools and capabilities in the Center to accomplish their research. For any inquiries regarding Center capabilities or tours, please contact Dr. Simon Ang, HiDEC Director, via email at siang@uark.edu or visit the HiDEC website at http://www.hidec.uark.edu.

DR. MAGDA EL-SHENAWEE INDUCTED INTO TEACHING ACADEMY

The University of Arkansas Teaching Academy welcomed six new members into its ranks in December. The academy is made up of faculty members who have established a record of outstanding teaching, and a mission to promote and stimulate an environment of teaching and learning excellence on the university campus.

One of the new inductees was Magda El-Shenawee, professor of electrical engineering in the College of Engineering. She teaches some of the most challenging core courses for electrical engineering and receives consistently high teaching evaluations. She has also guided the honors thesis of many undergraduates on such topics as nano-antennas, enhanced plasmonic antennas and early breast cancer detection. She won the John Imhoff Teaching Award, the top teaching award in the College of Engineering, in 2010.
NEW AND RETURNING STAFF MEMBERS

The Electrical Engineering Department is pleased to introduce new and returning staff members.

Kim Gillow has joined the Department as an Administrative Support Supervisor, working at the NCREPT/GRAPES facility. She received her B.S. Degree in Biology from the University of Arkansas in 2011.

Tim Brinkley is the new Test Engineer for the NCREPT facility. Tim received his B.S. Degree in Electrical Engineering from Arkansas Tech University in 2003. He is working toward his MSEE and also recently received confirmation that he successfully passed the PE exam.

Chris Farnell has returned to the Department as a Computer Support Specialist. Chris served in the US Air Force, and then worked for the Electrical Engineering Department while completing his BSEE, which he received in 2010. He recently returned to the University and is working toward his PhD in Electrical Engineering.

Kathy Kirk joined Department as an Administrative Support Supervisor in October of 2011. She serves as Program Manager and for the NSF Vertically-Integrated Center for Transformative Energy Research (VICTER) and provides administrative support to the center director at the Cato Springs Research Center.

Alison Brown is the newest member of our team, having just joined us in February. She serves as Program Manager for the NSF EPSCoR Green Renewable Energy-Efficient Nanophotonic (GREEN) Solar Cells Center and will coordinate visits of the GREEN Mobile Solar Energy Laboratory to K-12 schools upon its completion. She graduated from Hamilton College in 2011 with a degree in Mathematics and German Studies.

Dr. Omar Manasreh was recently named as a Fellow of the Institution of Engineering and Technology (IET). IET is one of the world’s leading professional societies for the engineering and technology community, with more than 150,000 members in 127 countries. To be named as a Fellow in the organization, an individual has to have “demonstrated significant individual responsibility and sustained achievement in their profession.”

The Vertically-Integrated Center for Transformative Energy Research (VICTER) has purchased a trailer to be used as an outreach/recruiting tool. Contained in the trailer are various pieces of equipment, including a Jacob's Ladder and a Solar Panel Demonstration, which can be used in K-12 recruiting. The hope is that scientific demonstrations of technology will create a greater interest in STEM fields.

At IEE ISGT 2012, students who have taken Dr. Balda’s Power Distribution Class connected with Turan Gonenc, author of “Electric Power Distribution System Engineering,” the textbook used in the class.

As usual, we want to hear about your accomplishments. For example, Douglas Hutchings and Seth Shumate of Silicon Solar Solutions were recently featured on the cover of INVENTORS magazine. Please, send your news to Mrs. Connie Howard at cjhowar@uark.edu.

Kind regards,

Juan Carlos Balda
Interim Department Head

GRAPES Generates the Interest of Industry at APEC 2012

GRAPES attended the Applied Power Electronics Conference and Exposition (APEC) for the second year this February. Joining nearly 200 other top companies, universities and research centers, GRAPES presented information on their current research projects and industrial membership opportunities. The GRAPES Center was represented by more than 10 faculty, staff and students working with the center, several of whom were attending the conference to present papers or chair sessions. GRAPES representatives explained to interested visitors how they are working to address challenges faced by companies working with grid-connected electronics, from component manufacturers to power providers.

Above, the GRAPES team at APEC.

Below left, Dr. Alan Mantooth (left) and T.A. Walton (center) discuss the mission of GRAPES with Don Burke (right) from Bodo’s Power Systems magazine.

Below right, GRAPES faculty, staff and students discuss GRAPES projects with exposition attendees.

A Word from the Department Head

Dear Alumni, students, friends of the department, and colleagues,

It is with great pleasure that we invite you to read your department newsletter informing you of our many activities ranging from teaching students, performing very exciting research and carrying out service and outreach activities.

Our students continue to make us very proud; Zach Bever, a sophomore, traveled to Belize over the winter break to work on a water tower as part of the UA section of Engineers without Borders. His story is on the back page of this newsletter. Often, the impact of engineering upon our world does not receive much attention.

The work of our faculty and staff members was recognized by others; Alan Mantooth was awarded the Alumni Research Award by the UA Alumni Association, and Magda El-Shenawee was inducted into the UA Teaching Academy. Please, join me in congratulating them. Also, Mr. T.A. Walton has taken the mobile power box across the state to talk to high school students in eastern Arkansas. This is a great outreach activity.

For your children or grandchildren, the department will continue hosting three summer camps for 6th-7th, 8th-9th and 10-12th graders in cooperation with the Dean’s recruiting staff. This year, we have obtained additional funding from the Arkansas Academy of Electrical Engineers so we will be subsidizing more high school students.

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Kind regards,

Juan Carlos Balda
Interim Department Head
GRANT HELPS RESEARCHERS DEVELOP BETTER SOLAR CELLS FOR SPACECRAFT

Researchers at the University of Arkansas and Arkansas State University will share more than $1 million in grant funding, partly from NASA with matching funds from each institution to investigate the use of semiconductor materials in photovoltaic devices that power satellites and other instruments in space. The funds, administered by the NASA EPSCoR office at the University of Arkansas at Little Rock, will enhance research opportunities in the state and could create high-tech jobs.

The National Science Foundation initiated EPSCoR — the Experimental Program to Stimulate Competitive Research — to encourage local action to develop long-term improvements in a state’s science and engineering enterprise.

“This research will have a significantly positive impact on the quality and competitiveness of the state’s academic research enterprise,” said Omar Manasreh, professor of electrical engineering at the University of Arkansas. “It will create new opportunities for further development in the field of novel photovoltaic materials and devices.”

The three-year grant totals slightly more than $1 million. The funding will allow researchers in Manasreh’s Optoelectronics Research Lab to continue growing and functionalizing semiconductor and metallic nanoparticles to be used in solar cells. He said this work could eventually lead to the start of a private company based in Arkansas. In 2010, Manasreh received a five-year $1.13 million grant from the U.S. Air Force Office of Scientific Research, which included cost sharing from the University of Arkansas, to pursue similar and complementary work.

The ultimate goal is to fabricate and test a photovoltaic device that is capable of possessing a solar energy conversion efficiency of 40 percent or better. Currently, solar panels used on NASA satellites and spacecraft use silicon-based technology, which cannot produce light-to-energy conversion efficiency greater than 23 percent.

Manasreh employs two approaches to fabricate solar cells. Instead of silicon, the first approach involves a combination of copper, indium, gallium and selenium (CuInSe2 and CuInGaSe2) as the semiconductor material to grow nanocrystals. The researchers make the nanocrystals functional by generating volatile ligands, which are molecules that bind to a central atom. The nanocrystals are then either converted into thin films or combined with titanium dioxide or zinc oxide nanotubes to create the desired solar cells. After fabrication of the cells, the researchers will test and evaluate their performance.

The second approach uses molecular beam epitaxy, a method of depositing nanocrystals, to create quantum dots made of indium arsenide (InAs). Quantum dots are nanosized particles of semiconductor material.

To enhance the performance of the solar cells, the researchers will use short ligands to couple metallic nanoparticles to the nanocrystals and quantum dots. They will then investigate the plasmonic effect of trapping sun light, which in turn increases the energy conversion efficiency. Just as a photon is the quantum of the electromagnetic waves, a plasmon is the quantum of charge waves generated by light.

Manasreh is member of the Institute for Nanoscience and Engineering at the University of Arkansas. His research has focused on experimental and theoretical optoelectronic properties of semiconductors, superlattices, nanostructures and related devices. He has worked extensively with electronic and optoelectronic applications, photovoltaic materials and devices and growth of nanomaterials. His recent work has focused on optoelectronic devices such as multi-color detectors and infrared detectors for focal plane arrays. Since joining the University of Arkansas in 2003, he has received more than $8 million in public research funding. This funding has been used to establish a state-of-the-art research lab with instrumentation ranging from nanomaterial characterization and device fabrication to device testing and evaluation.

IEEE Kick-off Meeting for ELEG Students on Fort Smith Campus

An IEEE kick-off meeting was held by the Electrical Engineering Students on the Fort Smith Campus on Tuesday, March 6, 2012. The EE students on the Fort Smith Campus want to form an IEEE section to increase interest, awareness, and involvement in the electrical engineering and in the program on the UA/F campus.

The topic of the presentation at the meeting was the introduction by Oklahoma Gas and Electric (OG&E) of “Smart Meter” technology by Ms. Penny Seale and Mr. John Townsend. This technology is now available to OG&E customers in Oklahoma and in the areas served by OG&E in western Arkansas. The “Smart Meter” technology allows OG&E to remotely control and read the electric meter through a wireless network. This also allows the customer to monitor their energy consumption over a website. The objective is to reduce peak energy consumption. Dr. Ahmed Hassan also made a presentation regarding the benefits of being an IEEE member. The faculty advisors for the section are Dr. Randle Overby and Dr. Ahmed Hassan.

The meeting was attended by a group over thirty EE students, professors and representatives from OG&E.

Also, on Friday, March 9, the students attended a presentation by Mr. Brad Randall of Randall Ford on the hybrid gas/electric vehicles and new totally electric vehicles produced by the Ford Motor Company. Mr. Randall had Ford vehicles available for test drives, and the students really were impressed with the overall performance of the totally electric vehicle. The students also had the opportunity to examine the electric vehicle designed and constructed by Dr. Kevin Lewelling of the UA/F electrical engineering department.

included several activities for graduate students and the university community, as well as focusing on outstanding doctoral students, past and present. The event culminated with a poster competition titled “From Abstract to Contract: Graduate Student Research Competition,” in which more than 170 graduate students from all academic areas presented their research and competed for prizes.

Prashanth Kumar, a doctoral student under Dr. Vijay Varadan, won the Physics category for his poster entitled “Wireless Brain-Machine Interface Using EEG and EOG: Brain Wave Classification and Robot Control”. He will receive a cash award and had his picture taken with Governor Beebe who spoke about the importance of research in terms of economic development and jobs. He added that sometimes the importance is not recognized by politicians since there is not instant or short term gratification when it comes to research. Congratulations to Prashanth and Dr. Varadan.

Other former or current students, working with Electrical Engineering faculty, who entered posters in the competition were Ranjith John, Mohammadi Khorrami, Anishkumar Manoharan, and Nadia Smith.

GRAPES Ushers in Third Year with Fall Semiannual Meeting

The NSF I/UCRC Grid-connected Advanced Power Electronic Systems (GRAPES) Center held its 5th semiannual meeting on November 8-9, 2011. The two-day meeting consisted of current project updates, new project proposals and student poster presentations.

This meeting marked several changes in leadership including the completion of Robert Yanniello’s (Eaton Corporation) term as Chairman of the Industrial Advisory Board (IAB). Mike Russ (North Little Rock Electric) stepped into the position of IAB Chairman for the Center’s third year and Ram Adapa (EPRI) was chosen to serve as Vice-Chair for the upcoming year.

The GRAPES Center welcomed Entergy, Inc. and Oak Ridge National Labs as new members in 2011 bringing the total IAB membership to 20.

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All in all, this was a great turn out for a series of very interesting events.
This past winter break 13 students from the University of Arkansas were involved in a service project in the Central American country of Belize. These students, members of the new student group Arkansas Engineers Abroad (AEA), were out to improve the lives of the approximately 150 villagers of More Tomorrow.

As a proud member of AEA, I am ecstatic to say that participating in this trip was one of the best experiences in my life. The work was long and grueling. The weather was warm and humid, and the ground was a muddy soup. But by the end of the week, I had developed 12 strong new friendships and took great happiness from the knowledge that I had actively worked to improve the lives of people I did not even know.

The story starts in August of 2010 when a man named Randy Gather brought to our attention the troubles of More Tomorrow. The village had four wells at the time and in each well waited a veritable cocktail of contaminants. When the first AEA delegation was sent to investigate the village and gather information, on-site testing revealed that the wells tested positive for some combination of fecal coliforms, staph, and E. coli. As a result, AEA dedicated itself to installing a new well and a water tower and connecting it to the local schoolhouse via a piping system because water quality is a primary stepping stone in improving the welfare of impoverished peoples. The village had been requesting a water tower for years from the government but had not been successful in getting one. We were trailblazing during the entire process. This proved to be one of the most difficult elements of the entire process; requiring constant effort and fundraising which we met with indefatigable resolve and perseverance.

Perhaps the most amazing part of this project was the fundraising. The fundraising is significant because as a group, we were committing to raise $17,000 in project costs (no travel costs included), and we had no fundraising history on which to fall back. We employed a multitude of methods to cover the costs including a garage sale, innumerable bake sales, corporate sponsorships, and a painting lesson. Additionally, the departments and the College of Engineering helped offset the cost of travel. Of note, I am particularly proud to report that the ELEG department generously covered my airfare. As an electrical engineer, there was not much I could contribute to the design as this particular project was intensive in the civil and biological disciplines. Instead, I dedicated myself to what I could do. I raised funds left and right, and when we were in country, I dug, wheelbarrowed, and put as much effort as I could muster into the labor. After we had completed our part of the manual labor – digging 4 3 foot cubes and filling them with concrete – we had removed 108 cubic feet of dirt and mud and filled the holes with a little over 4 tons of concrete. The actual assembly of the tower, well, and piping system were contracted out to locals with experience in construction projects.

The entire process was exceedingly educational. I learned much about the other disciplines, particularly civil engineering. Our civil engineers were eager to explain the processes and fundamentals behind the “why’s”. I learned the role of rebar and aggregate as well as the varying properties of concrete. Furthermore, the group took away many lessons in project management (communication, communication, communication) and budgeting-critical skills in any discipline.

As Vice President of AEA, I encourage everyone to investigate and participate in AEA. There is an open offer to join us however you can. Now that we have our feet wet and we have a more diverse group of students with a plethora of skills to contribute, we are looking to diversify our projects. We want to involve all disciplines, and to that end, we are seeking input from all corners. We have a website and a Facebook group to share our story and information: arkansasengineersabroad.blogspot.com and https://www.facebook.com/groups/253866421332145/. Furthermore, you can contact me, Zach Bever, at zbever@uark.edu.