Florida Energy Systems Consortium

FLORIDA ENERGY CONNECTIONS

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Florida Energy Systems Consortium

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Upcoming Events:

2012 Public Lecture– Ocean Renewable Energy Harnessing the Power of the Sea- April 19, 20, & 30, 2012

Researchers– Tap Into a New Source of Funding– April 20, 2012

Solar Energy & Efficiency Expo– April 21, 2012

FESC Outreach Activities

By: Nicholas Taylor and M. Jennison Kipp

As the outreach arm for FESC, the University of Florida's Program for Resource Efficient Communities (PREC) is often asked to recommend the best energy saving device (s) to either include in a new home or add or replace in an existing home. To help answer this question, PREC works with various stakeholders, evaluating a wide range of energy-efficiency programs to quantify their impacts and relative measures of energy and economic performance. These analyses address the need to accurately and reliably compare homes' energy efficiency and to understand the energy and monetary benefits of making specific energy-efficiency retrofit investments. Resulting energy savings estimates can provide a basis for prioritizing and targeting specific retrofit programs that are likely to optimize efficiency gains.

Findings of a recent study, supported by the National Renewable Energy Laboratory (NREL) and the Orlando Utilities Commission (OUC), have been incorporated directly into the Osceola Energy Initiative (OEI) Energy Efficient Finance Program (EEFP). As a U.S. Department of Energy (DOE) Energy Efficiency and Conservation Block Grant (EECBG) initiative under the American Recovery and Reinvestment Act of 2009 (ARRA), the OEI must show measurable and verifiable success in its programmatic goals and objectives. In turn, the EEFP

FESC Outreach Activities continued on page 2

FL CAN Develops Catalog for 'Cleantech' Companies

By: Julia Harper, Marketing Coordinator, Office of Technology Transfer, University of Central Florida

Florida Cleantech Acceleration Network, FL CAN, has published the only catalog of "cleantech" research from FESC universities, which is available on its website, www.FLcleantech.com. This information is also posted at the FESC web site.

In one of the first phases of the project, led by UCF, in partnership with FESC and TRDA, research conducted at FESC universities was collected, organized and indexed to provide entrepreneurs, investors and industry an easy reference to the latest in cleantech innovations in Florida. Cleantech refers to products, services and processes that utilize renewable materials and energy sources, and subsequently reduce emissions or waste.

There are more than 300 patented technologies collected from six Florida universities and organized into two listings, by university and technology. These categories range from solar to fuel cells to displays. Each technology listed contains a link that takes the reviewer to a description of the technology. Users can find additional information on the website, including how to contact the universities directly for collaborative opportunities.

The technologies listed in the University IP (Intellectual Property) Catalog are available for licensing and are supported by the network of Florida universities, their researchers, technology-transfer offices and select laboratories for further R&D and commercialization.

By licensing research from Florida universities, entrepreneurs, investors and industry support the state's economy, education and researchers, and they can accelerate their company's R&D at a faster rate than if it were done internally.

The catalog is continually updated as new innovations are made and patented. The FL CAN project was funded by a $1.3 million Economic Development Administration grant last fall to drive technology commercialization and entrepreneurship to support a "green innovation economy."

For more information on the FL CAN project and the Cleantech IP Catalog, click here

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will rely on the availability of valid, transparent comparisons of energy consumption data to measure and verify the efficacy of property improvement measures to be implemented as part of a retrofit loan program for Osceola County. OUC provides electric service to residential customers in Osceola County, and analysis of their energy consumption data merged with housing characteristics data provide the means to generate the types of energy performance comparisons necessary for successful implementation of the OEI EEFP. This analysis provided estimates of program impact for direct use by OUC staff and directly informed key components of the OEI EEFP, such as market segmentation and targeting, loan risk assessment, and pre- vs. post-intervention measurement and verification (M&V).

The overarching goal of PREC's work in evaluating energy conservation programs is to provide accurate and objective information on the costs and benefits of efficiency retrofits in a way that will help Florida businesses and residents save energy and money. Until all of the data are analyzed and final results are available, we encourage homeowners interested in learning more about energy efficiency in their homes to view the fact sheets available on the FESC Web site (http://www.floridaenergy.ufl.edu/?page_id=273).

The State of Solid-state Batteries– Planar Energy's Solid-state Cells

Dr. Kevin Jones at the University of Florida is one of the recipients of FESC Technology Commercialization Phase II funding. He is collaborating with Planar Energy under this program. The article below describes the Planar Energy technology.

By Scott Faris, Planar Energy

(Ref: American Ceramic Society Bulletin, Vol. 91, No. 2)

Planar Energy (Orlando, Fla.) has developed a new process for fabricating solid-state cells for rechargeable batteries that eliminates the slow formation step and eliminates vacuum deposition. The patent-pending process, known as Streaming Process for Electroless Electrochemical Deposition (SPEED), deposits nanostructured materials grown from solution. Advantages of solid-state cells over conventional lithium-ion cells include:

- Compact: 100 % increase in the energy density;
- Lightweight: 50 % increase in specific energy;
- Reliable: improved cycle life, low self-discharge;
- Recyclable: solid-state materials are completely recyclable; and
- Safe: no explosion hazard.

The cell architecture developed by Planar Energy replaces the plastics and organic binders of conventional lithium-ion cell electrodes with durable, self-assembled inorganic binder films. Demonstration working cells have been fabricated that incorporate high-energy-density electrodes and high-conductivity inorganic solid-state electrolytes. Batteries made from these rechargeable cells will have capacity ranges of several amp-hours and are packaged in prismatic formats.

SPEED technology

SPEED is a refined chemical bath deposition process that allows the substrate to be coated with nanoparticles at high growth rates, with no limitation on film thickness. SPEED technology offers several improvements over currently available deposition technologies:

- Direct self-assembled nanomaterial film deposition;
- High-quality film growth on any hydrophilic substrate;
- Suitable for large surface area substrates;
- Higher deposition rates;
- Suitable for discrete or continuous roll to-roll manufacturing processing;
- Self-purifying process allows use of lower-purity raw materials;
- Uses environmentally friendly water soluble materials; and
- Very flexible chemistry formulation for binary or more complex compound materials growth.

State of Solid-state Batteries continued on page 7

FESC Partnership with Petra Solar

By Issa Batarseh and John Shen

Petra Solar is a technology company, focused on providing reliable, cost effective smart energy solutions to the electric supply industry. Founded in 2006 with licensing several key inventions developed at UCF, Petra Solar revolutionized the distributed solar and smart grid industry by pioneering Smart Solar technology that combines distributed solar energy generation with smart grid communications and improved grid reliability features to create a utility grade solution that delivers high economic value for solar power.

Petra Solar has developed an innovative SunWave™ Smart Solar system that allows a PV panel, a micro-inverter, and the communication unit to be mounted on a utility or light pole or the rooftop of residential and commercial buildings. Petra Solar has signed a $200 million contract with a leading U.S. utility company to deploy this technology on a very large scale.

UCF and Petra Solar partnership began in 2007 when Petra solar recruited several doctoral students from UCF and funded UCF for $900K to carry on research and development activities. The partnership continued when FESC was launched. Since 2009, FESC has played a major role in the company's success in developing new smart energy technology. The power electronics research at the University of Central Florida, supported by FESC grants, was closely tied into Petra Solar's technology development. With Petra Solar's R&D center located in the UCF Research Park, Petra Solar benefited greatly for its partnership opportunities including carrying out joint research and development, student training and internships, and talent attraction and recruitment.

"The role of UCF research and FESC's support in Petra Solar's success cannot be overstated. We worked as a team and together accomplished a lot," says Khalid Rustom, former UCF researcher and now a business development manager at Petra Solar.

"The partnership between UCF and Petra Solar exemplifies the central idea of our center in fostering commercialization of university research and aiding the economic development in the state of Florida," said Professor Issa Batarseh, the Director of Florida Power Electronics Center at UCF, and co-founder of Petra Solar.

For more information, please feel free contact Dr. John Shen, FPEC Associate Director, at johnshen@ucf.edu.

New Aeropropulsion, Mechatronics and Energy (AME) Building at FSU

The new AME building becomes the latest addition to a world class group of facilities located in Innovation Park at FSU's Southwest Campus. The AME Building's neighbors include the Mag Lab, FAMU-FSU College of Engineering, recently completed Material Research Building, Center for Applied Superconductivity in the Shaw Building, as well as the Research Foundation Buildings A&B.

This 60,000 ft^2 state-of-the-art facility supports advanced research in aerospace and aviation, mechatronics (robotics) and sustainable energy engineering. The AME building houses laboratories, equipment, offices and other infrastructure necessary to carry out the university's research mission in several key areas that are crucial to the economic development of the state and nation. Some of the organizations housed in this $23 million facility are the university's Center for Intelligent Systems, Control and Robotics (CISCOR) and Florida Center for Advanced Aero-Propulsion (FCAAP), which is a State University System Center of Excellence that is headquartered at FSU.

As its name indicates, the research that takes place within the Aero-Propulsion, Mechatronics and Energy Building focuses on three key areas:

- **Aero-propulsion**: The discipline of aero-propulsion deals with transportation systems and other objects that move through air, influencing the design and fabrication of aircraft, spacecraft, automotive transport, and all manner of vehicles in motion. The relevant research areas cover fundamental science topics such as aerodynamics, fluid mechanics, acoustics, thermal physics and turbulence, as well as practical applications such as combustion improvement, active control of flow separation, supersonic jet noise suppression, lift/thrust enhancement and drag reduction.

- **Mechatronics**: The term mechatronics, a combination of mechanics and electronics, was first used in Japan in the 1960s. From a technical perspective, it is the synergistic integration of mechanical, electrical, control and computer systems to create functional products. Mechatronics has become the enabling technology responsible for industrial innovations in numerous economic sectors, including automobiles, alternative energy, aerospace, electronics and defense. The field of mechatronics generally covers topics such as robotics, micro-electro-mechanical-systems (MEMS), intelligent systems, automated guided vehicles and smart materials.

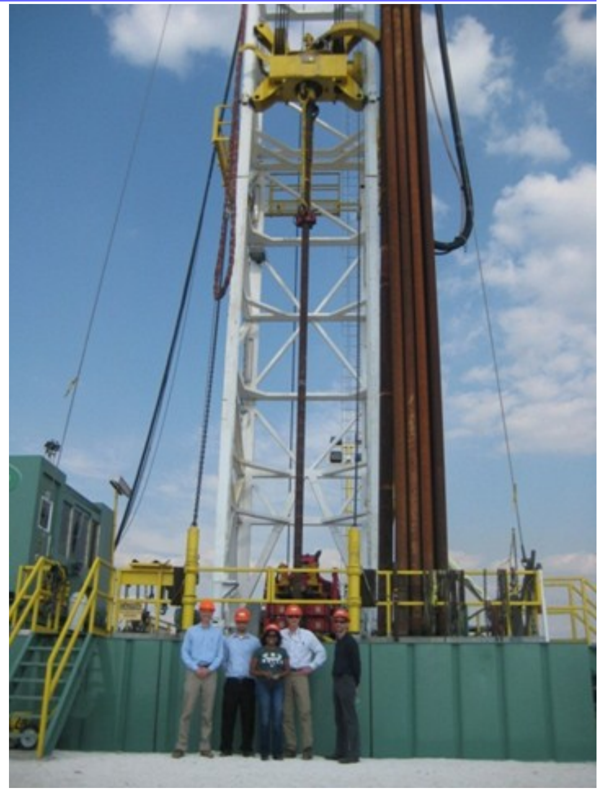
AME Building at FSU continued on page 6

FESC-USF Carbon Sequestration Group

Carbon capture and sequestration is part of a $171 million DOE technology demonstration project at Tampa Electric's Polk Power Station, Florida, taking place over the period of 2011 through 2015.

As part of this major demonstration, FESC-USF faculty and graduate students are studying the effects of injecting 300,000 tons of carbon dioxide into a deep saline zone under central Florida. The well injection zone will extend from a depth of 4300 to 8000 ft below the land surface.

The adjacent figure shows, from left to right, USF PhD students Arlin Briley and Mark Thomas, and USF faculty members Maya Trotz, Mark Stewart, and Jeff Cunningham



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Energy: Seeking new energy resource that are more efficient and cost-effective and that minimize effects on the environment is among the most critical issues that the world will have to grapple with in the 21st century. The Aero-Propulsion, Mechatronics and Energy Building houses research labs for organizations that are focused on exploring reliable, affordable, safe and clean energy technologies, including projects such as fuel-cell, advanced battery technologies, smart grid, thermal and power management for distributed energy systems.

The AME Building has been designed and constructed with attention paid to fostering collaborative research between the building's occupants and other nearby researchers. Therefore, it is no accident that the design utilizes similar materials and techniques as its close neighbors. Metal panel skin, brick colors, window treatment, and site planning were carefully coordinated by the architect to reinforce the building's image as a unique center for the study of aerospace engineering components, energy management engineering, and robotic devices. Interior spaces were clustered in a way to support extended building hours and bring the occupants together spontaneously to support multi-disciplinary collaboration.

Also the AME Building incorporates design and construction that adheres to sustainable practices. Special care was paid to the building's energy consumption and to the indoor environment. Day lighting was used to reduce the need for artificial lighting. Materials were chosen for their ability to support recycling.

Ref: http://www.facilities.fsu.edu/share/Human_Resources/Current_Newsletter.pdf and

http://www.eng.fsu.edu/me/research/ame.html

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There are three SPEED deposition methodologies:

Liquid-Phase SPEED (LPSPEED), where the substrate has a controlled liquid precursor covering it with a controlled replenishment and recirculation process;

Vapor-Phase SPEED (VPSPEED), where precursor droplets on the order of 1 to 15 µm are generated and impinge on the substrate surface; and

Gel Phase SPEED (GPSPEED), where the precursor is impregnated in a gel.

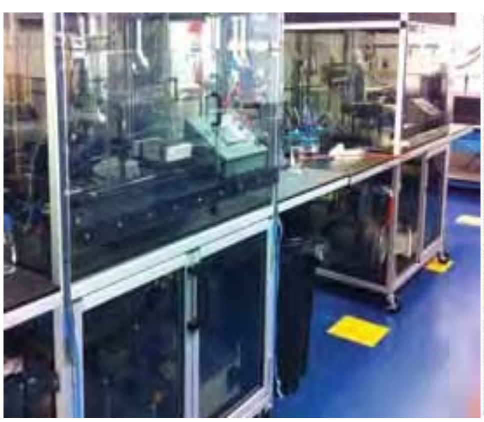
The LPSPEED process grows film at a rate ranging from 10 to 100 nm per minute. The VPSPEED process offers higher growth rates, reaching more than 100 nm per minute. The GSPEED process grows film at a rate much higher than 1,000 nm per minute. Figure 1(a) shows the automated VPSPEED system and the semi-automated LPSPEED system.

Growth Medium: Deionized water is the preferred growth medium. The aqueous solution consists of water-soluble compounds with complexing agents mixed to discourage unwanted homogeneous reactions and to ensure that film growth takes place only by heterogeneous reaction on the substrate.

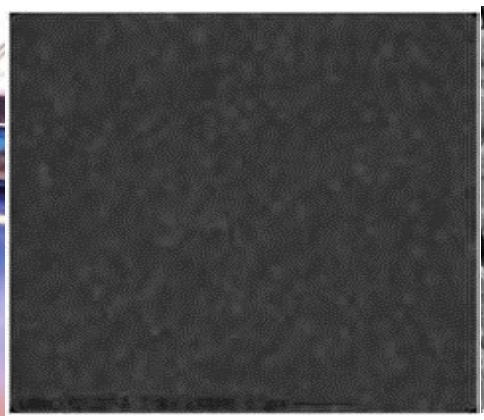
Substrate: The substrate in all cases is maintained at a temperature ranging from 125 to 300°C. The substrate is hydrophilic to enable hydroxyl ions (OH^-) in the growth bath (LPSPEED), droplet (VPSPEED) or gel (GSPEED) to adhere to the substrate.

Film Growth: The OH^- attachment sites on the substrate are the nucleation sites, with more than 10^{12} of these sites per cm^2. The heterogeneous reactions that eventually lead to the formation of the desired molecules occur only if the substrate temperature is sufficiently high to drive the reactions. The lateral growth of grains on the substrate is short lived, because there are millions of these occurring simultaneously until the surface area is consumed.

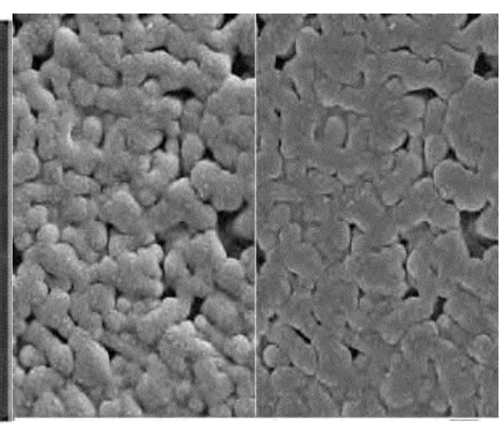
Film Quality: The film consists of densely packed grains with lateral sizes in the nano range of 50 to 100 nm, as shown in Figure 1(b). SPEED directly deposits nanoparticle-based films on metallic, glass and plastic substrates. Recrystallization of the film readily takes place with post growth temperature annealing, as shown in Figure 1(c).



The automated VPSPEED system for 4 inch 3 4 inch substrates and the LPSPEED 4 inch 3 4 inch system.



Top-down scanning electron microscope view of MnO as deposited by SPEED on plastic. This image shows densely packed grains, with sizes ranging



Top-down SEM image of SPEED-grown LiMn2O4 on stainless steel, post annealed at 700°C in O2 showing larger interconnected grains that are an agglomeration