KPPC Kentucky's Resource Center for Environmental Sustainability

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Company's Black Silicon Cells Have Lowest Reflectance Ever Recorded for Silicon Solar Cells

Scientists at Natcore Technology Inc., using simple liquid bath processes, have created a black surface on a silicon wafer with an average reflectance in the visible and near-infrared region of the solar spectrum of 0.3 percent, making it the "blackest" silicon solar cell surface ever recorded. Compared with standard production cells now available, this represents a tenfold reduction in reflectance over that portion of the spectrum, which is the source of about 80 percent of the usable power that can be drawn from sunlight.

A panel made from black silicon solar cells will produce significantly more energy on a daily basis than will a panel made from cells using the industry standard antireflective coating. First, because it reflects less light. Second, because it performs better during the morning and afternoon hours when the sun hits at an angle. (It also outperforms standard cell panels on cloudy days.) Its higher energy output, combined with a lower cost using Natcore's patented process, could quickly make black silicon the global solar technology of choice.

This is the latest milestone in Natcore's drive to improve the performance of solar cells. Conventional cells, with antireflective coatings made via a chemical vapor deposition process that requires a high-temperature vacuum furnace and hazardous gases, have a reflectance of about 4%. With black silicon, the U.S. Department of Energy's National Renewable Energy Laboratory (NREL) lowered the number below 2 percent. Now Natcore's technology has reduced it to 0.3 percent, or virtually zero. "Absolute black is to reflected light as absolute zero is to heat." says Dr. Dennis Flood, Natcore's Chief Technology Officer.

Natcore was recently granted an exclusive license by NREL to develop and commercialize a line of black silicon products based on NREL patents. Natcore's reflectance accomplishment came about as a natural part of its work associated with that license.

"We are already working with two equipment manufacturers to design a production tool," says Natcore President and CEO Chuck Provini. "The tool would make 2,000 black silicon wafers per hour. We'll establish other parameters in our lab. When the design is completed, we'll take orders for the tool. We have already

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begun talking with potential customers in Italy, China and India."

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White Paper Finds Lithium Ion Battery Costs Beat Lead Acid in Hot Environments

AllCell Technologies has released a white paper comparing the economics of lithium-ion and lead acid batteries for stationary energy storage systems (ESS). Even though the initial purchase price of lead acid batteries is one-fifth the price of lithium-ion, when analyzed on a full life-cycle basis lithium-ion batteries are now cost-competitive in moderate climates and lower cost in hot climates. As solar photovoltaic costs continue to fall, the lightweight, long life cycle and deep discharge capacity of lithium-ion battery systems will enable a growing range of mobile, portable and off-grid products and applications to become economically feasible.

The analysis included a case study of a system requiring 50 kilowatt-hours of electricity per day, and compared valve regulated lead acid (VRLA) batteries to AllCell's standard ESS modules in a moderate climate of 25°C (77°F) and a hot climate of 33°C (91°F). For the lead acid system, after taking into account the lower depth of discharge, climate-adjusted cycle life, and increased transportation and installation costs, the total cost per kWh delivered over 5 years came out to $0.34 in the moderate climate and $0.67 in the hot climate. The lithium-ion system came out to $0.40 per kWh delivered, 18 percent higher than lead acid in the moderate climate but 40 percent lower in the hot climate. The driver of this large difference is the reduced cycle life of lead acid in hot environments. The eight degree Celsius increase in average temperature between moderate and hot climates cuts the estimated cycle life of lead acid batteries in half, while the lithium-ion battery maintains the same cycle life in both environments.

The lithium-ion modules analyzed included AllCell's proprietary phase change material (PCM) composite, which improves the cycle life of lithium-ion cells by passively absorbing and distributing heat. When a battery is placed in a hot outdoor environment, the PCM can absorb heat during the day and release it back into the atmosphere at night. Including PCM thermal management in battery modules enables the production of compact, lightweight, long-lasting energy storage systems. In addition to hot environments, the technology is applicable for mobile, portable, rooftop and off-grid applications.

According to AllCell CEO Said Al-Hallaj, "Innovative system integrators are beginning to realize that lithium-ion's longer cycle life justifies the higher initial cost in the right environment. Initial purchase price is only one input into the true life cycle economics. The more remote and rugged the installation site, the less important upfront cost becomes and the more important factors like cycle life, maintenance, transportation cost, size and weight become."

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KREC Administrator, KPPC Receives Second Consecutive Energy Star Partner of the Year Award

KPPC has been chosen as a 2012 Energy Star award winner by the U.S. Environmental Protection Agency for the second consecutive year. The EPA introduced its Energy Star partnership program in 1992 to reduce greenhouse gas emissions and other pollutants associated with energy use. Other Kentucky recipients of the program delivery awards were the Commonwealth of Kentucky and the Kentucky Housing Corp.

KPPC's recognition was for helping clients build self-sustaining energy management programs. The Center uses Energy Star's management guidelines for its series of tools, training and other resources for clients and encourages clients to become Energy Star partners, use its tools and participate in its initiatives.

For example, to date, 128 Kentucky school districts have become Energy Star partners through participation in KPPC's Kentucky Energy Efficiency Program for

Schools. Last year KPPC conducted 198 on-site energy efficiency assessments that identified ways to produce a projected annual cost savings of $6.5 million. Also, through the Center's Kentucky Save Energy Now initiative, 26 industrial and commercial facilities have committed to reduce energy use by 2.5 percent annually for 10 years.

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KPPC Executive Director Cam Metcalf (right) and Assistant Director Lissa McCracken (left) accepted the award at a March 15 ceremony in Washington, D.C., from Jean Lupinacci, Chief, Energy Star Commercial and Industrial Branch.

Zero Energy Buildings On the Rise Using On-site Renewable Energy Resources

A report released this month by the New Buildings Institute (NBI) and the Zero Energy Commercial Building Consortium reveals that zero energy commercial buildings—highly efficient buildings that produce as much energy as they use through on-site renewable resources—are cropping up across the United States from sunny California to snowy New York state.

The report, "Getting To Zero 2012 Status Update: A First Look at the Costs and Features of Zero Energy Commercial Buildings" examines the number, location, costs and design strategies of various types of zero energy commercial buildings as well as zero energy-capable buildings, which are energy efficient enough to be zero energy, but have not taken the final step of on-site renewable generation. It is the most comprehensive look at the state of zero energy commercial buildings to date. Read more and download the report.

NBI is a nonprofit organization working collaboratively with commercial building professionals and the energy industry to promote better building energy performance.

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Researchers Create More Efficient Hydrogen Fuel Cells

From ScienceDaily. Hydrogen fuel cells, like those found in some "green" vehicles, have a lot of promise as an alternative fuel source, but making them practical on a large scale requires them to be more efficient and cost effective.

A research team from the University of Central Florida may have found a way around both hurdles.

The majority of hydrogen fuel cells use catalysts made of a rare and expensive metal -- platinum. There are few alternatives because most elements can't endure the fuel cell's highly acidic solvents present in the reaction that converts hydrogen's chemical energy into electrical power. Only four elements can resist the corrosive process -- platinum, iridium, gold and palladium. The first two are rare and expensive, which makes them impractical for large-scale use. The other two don't do well with the chemical reaction.

UCF Professor Sergey Stolbov and postdoctoral research associate Marisol Alcántara Ortigoza focused on making gold and palladium better suited for the reaction. They created a sandwich-like structure that layers cheaper and more abundant elements with gold and palladium and other elements to make it more effective.

The outer monoatomic layer (the top of the sandwich) is either palladium or gold. Below it is a layer that works to enhance the energy conversion rate but also acts to protect the catalyst from the acidic environment. These two layers reside on the bottom slice of the sandwich -- an inexpensive substrate (tungsten), which also plays a role in the stability of the catalyst.

"We are very encouraged by our first attempts that suggest that we can create two cost-effective and highly active palladium- and gold-based catalysts -for hydrogen fuel cells, a clean and renewable energy source," Stolbov said. Stolbov's work was recently published in The Journal of Physical Chemistry Letters.

By creating these structures, more energy is converted, and because the more expensive and rare metals are not used, the cost could be significantly less. Stolbov said experiments are needed to test their predictions, but he says the approach is quite reliable. He's already working with a group within the U.S. Department of Energy to determine whether the results can be duplicated and have potential for large-scale application.

If a way could be found to make hydrogen fuel cells practical and cost effective, vehicles that run on gasoline and contribute to the destruction of the ozone layer could become a thing of the past.

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KREC would like to publish your thoughts on renewable energy and energy efficiency in Kentucky in the "Members' Forum". Please send your opinions, articles or news about RE happenings in the Commonwealth to KREC@kppc.org. A short piece is preferable (300 or fewer words work best).

Make your voice heard – we want to give KREC members a forum to spread the word about renewable energy efforts and issues.

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