

## Developments in Energy Research

### Virus-enabled fabrication of stable silicon anodes for lithium-ion batteries

Most of today's lithium-ion batteries rely on anodes made from graphite, a form of carbon. Silicon-based anodes, for example, theoretically offer as much as a ten-fold capacity improvement over graphite, but silicon-based anodes have so far not been stable enough for practical use.

In the work "Virus-Enabled Silicon Anode for Lithium-Ion Batteries," Chunsheng Wang, an assistant professor in the Department of Chemical & Biomolecular Engineering at the University of Maryland, together with two other principal investigators (James Culver and Reza Ghodssi) and their teams have used the macromolecular structure of self-assembled Tobacco mosaic virus (TMV) as templates to fabricate three-dimensional current collectors for high power and high energy density Li-ion batteries.

Further information: *ACS Nano* **2010**, *4*, 5366–5372; DOI: 10.1021/nn100963j

### Nano-sized crystalline material for energy conservation

A cover story in the September issue of *Small* features a method developed by



UConn chemistry professor Steven Suib for the production of a nano-sized crystalline material that will be used for energy conservation. "The cover of *Small* is highly coveted," says Bernhard Rügemer, production manager. "It is instantly recognizable, and associated worldwide with the highest quality research from the top researchers in the field." The issue, reports on basic science research into a new material that could be used as a catalyst in alternative fuel development.

The image shows hollow rods of titanium oxide with the solid manganese oxide core removed. The nanomaterial, developed using Suib's method, consists of two materials, one a template and the other a material that can grow around it in a well-ordered array. The growth can be controlled and uses solar energy to drive reactions such as the splitting of water into hydrogen and oxygen. The material acts as a catalyst in a process chemists call photocatalysis, which is the acceleration of a photoreaction in the presence of a catalyst.

Further information: *Small* **2010**, *6*; DOI: 10.1002/smll.201090027.

### 1st International Conference on Clean Energy

The 1st International Conference on Clean Energy in Dalian, PR China from 10–13 April 2011, offers a unique opportunity for international researchers to discuss the latest developments in clean energy and energy storage research, and the fundamental issues surrounding the scientific challenges faced ahead. Themes cover the whole range of clean energy including:

- The conversion of solar energy into chemical fuel, that is, water splitting, CO<sub>2</sub> reduction
- The conversion of solar energy into electricity, and solar cells
- The storage of solar energy
- Accessing solar energy from natural sources—biofuels

- CO<sub>2</sub> utilization and storage
- Materials for energy storage
- New technologies in clean energy

There will be plenty of opportunities to present your work in the conference's parallel sessions. Abstracts are welcome for both oral and poster presentations.

Further information: <http://www.icce.cas.cn>

### Cri-Cri, the all-electric aircraft, is airborne

The all electric Cri-Cri, jointly developed by EADS Innovation Works, Aero Composites Saintonge, and the Green Cri-Cri Association, has made its official maiden flight at Le Bourget airport near Paris. This Cri-Cri is the first-ever four-engined allelectric aerobatic plane, which was first shown at the Green Aviation Show at Le Bourget in June. Take-off and climb were smooth, no vibrations could be felt and manoeuvrability was excellent. All systems performed well and the plane returned safely after 7 minutes. "This aircraft flies very smoothly, much more quietly than a plane with conventional propulsion," said Didier Esteyne, who piloted the all-electric Cri-Cri. "But we are still at the beginning and have a lot to learn. We are allowed to start aerobatic manoeuvres only after five hours of flight and 15 landings."

Further information: <http://www.aviationnews.eu/2010/06/18/cri-cri-the-all-electric-aircraft/>

### Americans use less energy overall and make more use of renewable energy resources.

The United States used significantly less coal and petroleum in 2009 than in 2008, and significantly more wind power. There also was a decline in natural gas use and increases in solar, hydro and geothermal power according to the most recent energy flow charts released by the Lawrence Livermore National Laboratory.

“Energy use tends to follow the level of economic activity, and that level declined last year. At the same time, higher efficiency appliances and vehicles reduced energy use even further,” said A. J. Simon, an LLNL energy systems analyst who develops the energy flow charts using data provided by the Department of Energy’s Energy Information Administration.

### Photon-enhanced thermionic emission for solar concentrator systems

Solar-energy conversion usually takes one of two forms: the “quantum” approach, which uses the large per-photon energy of solar radiation to excite electrons, as in photovoltaic cells, or the “thermal” approach, which uses concentrated sunlight as a thermal-energy source to indirectly produce electricity using a heat engine. In a publication in *Nature Materials* Jared W. Schwede et al. present a new concept for solar electricity generation, photon-enhanced thermionic emission, which combines quantum and thermal mechanisms into a single physical process. The device is based on thermionic emission of photo-excited electrons from a semiconductor cathode at high temperature. Temperature-dependent photoemission-yield measurements from GaN show strong evidence for photon-enhanced thermionic emission, and calculated efficiencies for idealized devices can exceed the theoretical limits of single-junction photovoltaic cells. The proposed solar converter would operate at temperatures exceeding 200 °C, enabling its waste heat to be used to power a secondary thermal engine, boosting theoretical combined conversion efficiencies above 50%.

Further information: *Nat. Mater.* **2010**, *9*, 762–767; DOI: 10.1038/nmat2814.

### Batteries for battery powered cars are more environmentally friendly than expected

It is not an easy task to compare the environmental effects of battery powered cars to those caused by conventionally fuelled automobiles. The degree to which manufacture, usage, and disposal of the batteries used to store the neces-

sary electrical energy are detrimental to the environment is not exactly known. Now, for the first time, a team of Empa scientists have made a detailed life cycle assessment (LCA) or ecobalance of lithium-ion (Li-ion) batteries, in particular the chemically improved (i.e., more environmentally friendly) version of the ones most frequently used in electric vehicles. The investigation shows that if the power used to charge the battery is not derived from purely hydroelectric sources, then it is primarily the operation of the electric car, which has an environmental impact, exactly as is the case with conventionally fuelled automobiles. The size of the environmental footprint depends on which sources of power are used to “fuel” the e-mobile. The Li-ion battery itself has, in contrast, a limited effect on the LCA of the electric vehicle. This is contrary to initial expectations that the manufacture of the batteries could negate the advantages of the electric drive.

Further information: <http://www.empa.ch/>

### Greening of petroleum operations

This state-of-the-art text covers some of the most hot-button issues in the energy industry, covering new, greener processes for engineers, scientists, and students to move petroleum operations closer to sustainability. Petroleum is still the world’s most diverse, efficient, and abundant energy source, however, due to grim climate concerns and high gas prices, there is a growing initiative from global leaders of petroleum to “go

green.” This book investigates and details how to do that.

Further information: ISBN-10: 0-470-62590-2

### Electricity collected from the air could become the newest alternative energy source

Imagine devices that capture electricity from the air—much like solar cells capture sunlight—and using them to light a house or recharge an electric car. Imagine using similar panels on the rooftops of buildings to prevent lightning before it forms. Strange as it may sound, scientists already are in the early stages of developing such devices, according to a report presented at the 240th National Meeting of the American Chemical Society (ACS).

“Our research could pave the way for turning electricity from the atmosphere into an alternative energy source for the future,” said study leader Fernando Galembeck. His research may help explain a 200-year-old scientific riddle about how electricity is produced and discharged in the atmosphere. “Just as solar energy could free some households from paying electric bills, this promising new energy source could have a similar effect,” he maintained. “If we know how electricity builds up and spreads in the atmosphere, we can also prevent death and damage caused by lightning strikes,” Galembeck said, noting that lightning causes thousands of deaths and injuries worldwide and millions of dollars in property damage.

Further information: <http://portal.acs.org/portal/acs/corg/content>

### Sustainability News

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