

# EEVC NEWSLETTER

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## ULTRA-FAST CHARGING BATTERY CAN LAST 20 YEARS

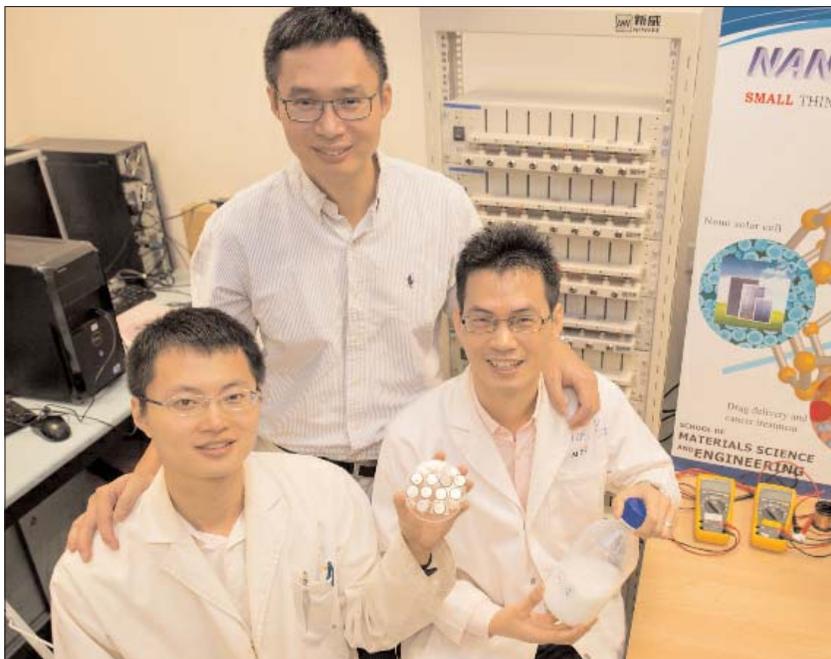
[Source:  
Nanyang  
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Scientists at Nanyang Technology University (NTU) in Singapore have developed ultra-fast charging batteries that can be recharged up to 70 per cent in only two minutes.

The new batteries also have a long lifespan of greater than 20 years, more than ten times that of existing lithium-ion batteries.

This can affect many industries, especially EVs, where consumers are put off by the long recharge times and limited battery life.

With this new technology EV drivers could save tens of thousands on battery replacement costs and can recharge their cars in just a mat-



(Clockwise from top) NTU Associate Professor Chen Xiaodong with research fellow Tang Yuxin and PhD student Deng Jiyang.

ter of minutes.

Lithium-ion batteries usually last about 500 recharge cycles. This is equivalent to two to three years of typical use, with each cycle taking about two hours for a full charge

In the new NTU-developed battery, the traditional graphite used for the anode (negative pole) in lithium-ion batteries is replaced with a

new gel material made from titanium dioxide.

Titanium dioxide ( $\text{TiO}_2$ ) is an abundant, cheap and safe material commonly used as a white pigment in paint, as a food additive, in sunscreen lotions to absorb ultraviolet rays and even in catalytic coatings that destroy air pollution in the presence of sunlight.

The NTU team has found a way to trans-

form the TiO<sub>2</sub>, which is naturally found in spherical shape, into nanotubes a thousand times thinner than a human hair. This speeds up the chemical reactions taking place in the new battery, allowing for superfast charging.

Invented by Associate Professor Chen Xiaodong from NTU's School of Materials Science and Engineering, the science behind the formation of the new titanium dioxide gel was published in the latest issue of *Advanced Materials*, a leading international scientific journal in materials science.

Prof Chen and his team will be applying for a proof-of-concept grant to build a large-scale battery prototype. With the help of NTUitive, a wholly-owned subsidiary of NTU set up to support NTU start-ups, the patented technology has already attracted interest from the industry.

The technology is currently being licensed by a company for eventual production. Prof. Chen expects that the new generation of fast-charging batteries will hit the market in the next two years. It also has the potential to be a key solution in overcoming longstanding power issues related to electro-mobility.

"Electric cars will be able to increase their range dramatically, with just five minutes of charging, which is on par with the time needed to pump petrol for current cars," added Prof Chen.

"Equally important, we can now drastically cut down the toxic waste generated by disposed batteries, since our batteries last ten times longer than the current generation of lithium-ion batteries."

The 10,000-cycle life of the new battery also mean that drivers of electric vehicles would save on the cost of battery replacements, which could cost over US\$5,000 each.

### **Easy to manufacture**

According to Frost & Sullivan, a leading growth-consulting firm, the global market of rechargeable lithium-ion batteries is projected to be worth US\$23.4 billion in 2016.

Lithium-ion batteries usually use additives to bind the electrodes to the anode, which affects the speed in which electrons and ions can transfer in and out of the batteries.

However, Prof Chen's new cross-linked titanium dioxide nanotube-based electrodes eliminate the need for these additives and can

pack more energy into the same space.

Manufacturing this new nanotube gel is easy. Titanium dioxide and sodium hydroxide are mixed together and stirred at a certain temperature, so battery manufacturers will find it easy to integrate the new gel into their current production processes.

### **Recognized as the next big thing by co-inventor of today's lithium-ion batteries**

NTU professor Rachid Yazami, the co-inventor of the lithium-graphite anode 30 years ago that is used in today's lithium-ion batteries, said Prof Chen's invention is the next big leap in battery technology.

"While the cost of lithium-ion batteries has been significantly reduced and its performance improved since Sony commercialized it in 1991, the market is fast expanding towards new applications in electric mobility and energy storage," said Prof Yazami, who is not involved in Prof Chen's research project.

Last year, Prof Yazami was awarded the prestigious Draper Prize by The National Academy of Engineering for his groundbreaking work in developing the lithium-ion battery with three other scientists.

"However, there is still room for improvement and one such key area is the power density – how much power can be stored in a certain amount of space – which directly relates to the fast charge ability. Ideally, the charge time for batteries in electric vehicles should be less than 15 minutes, which Prof Chen's nanostructured anode has proven to do so."

### **PUTTING ONE'S MONEY WHERE ONE SEES THE FUTURE**

**Oliver Perry**

"Buffett Puts the Wind in His Sails." *The Wall Street Journal*, Friday October 24, 2014.

Section Money & Investment Page C1.

Warren Buffett, according to the *WSJ*, acquired a utility company (Mid American Energy Holdings Co.) in 2000 and has sunk billions into wind-farm projects in a big gambit on renewable energy. He plans to double the already \$15 billion committed to renewable energy and is on the hunt for more utility acquisitions. Charles T. Munger, Mr. Buffett's longtime business partner and Berkshire's vice chairman, predicted last month

that the company would be the biggest utilities business in the United States in a few years. The energy unit is key to Berkshire's future. It generates more than 7 percent of the conglomerate's earnings and is likely to climb. The energy sector provides Berkshire a place to invest its ever-growing cash pile of over \$55 billion.

Buffett claims that people will always need power regardless of the state of the economy. He likes to quip that owning a utility is not a way to get rich but rather to stay rich. And, getting in on renewable energy early will give him an edge in the long transition from traditional means of producing electricity to newer forms.

Berkshire Hathaway Energy doesn't pay any dividends to its shareholders. Instead it reinvests its earnings (12 percent) into the business which government regulators encourage. Utilities require heavy investments to maintain and upgrade their grids. Regulators allow energy monopolies to operate in exchange for keeping their rates low. Rates of return are set by the regulators. Many of Berkshire's customers pay lower rates than the national average.

Since 2004 Berkshire has invested \$5.8 billion into wind projects in Iowa. His company has added 3300 MW of wind generating capacity. Andrew Bischof, an equities analyst at Morning Star Inc., called Berkshire Hathaway Energy one of the largest top performing utilities of the last half-decade by return on capital. He values the company at \$31 billion.

## NEWS UPDATE

### **Car hacking: the security threat facing our vehicles**

From Queensland University of Technology (QUT), Sept 17, 2014

The car of the future will be safer, smarter and offer greater high-tech gadgets, but, be warned, without improved security the risk of car hacking is real, according to a QUT road safety expert.

Professor Andry Rakotonirainy was scheduled to speak at the Occupational Safety in Transport Conference (OSIT) on the Gold Coast on September 18-19 on the security

threat facing drivers as vehicles become computers on wheels.

Professor Rakotonirainy, from QUT's Centre for Accident Research & Road Safety – Queensland (CARRS), has researched the security systems of existing fleet, future autonomous and connected cars and found there was little protection against hacking.

“The security protection on cars is virtually non-existent, it is at a level of protection that a desktop computer system had in the 1980s, the basic security requirements such as authentication, confidentiality and integrity are not strong,” he said.

“What this means is that as vehicles become more and more connected and autonomous, with the ability to communicate to other vehicles and infrastructure through wireless networks, the threat of cyber attack increases putting people's safety and security at risk.”

Professor Rakotonirainy said while most vehicles built within the last decade had features allowing them to connect to the internet and communicate with devices within the vehicle, the development of intelligent transport systems meant future cars would be connected to wireless networks as standard and would offer a higher level of automation.

He said all new cars were equipped with technology, called CAN-BUS, located under the steering wheel, allowing anyone to check the health of a vehicle and to control it.

CAN-BUS provides access to the “brain” of a car.

“This CAN-BUS allows all microcontrollers within a car to communicate to each other and is accessible via a mere plug,” he said. “It can be used to control almost everything such as the air bags, brakes, cruise control and power steering systems. CAN-BUS can be accessed locally or remotely with simple devices.

“This is just the tip of the iceberg as future cars will feature a tremendous mix of wireless networks and offer numerous opportunities to improve safety, entertainment and comfort.

“For example, cars will be wirelessly connected to other cars. If a vehicle stops ahead, a warning can be issued to drivers behind to slow down, or vehicles can automatically take control and slow down without the driver's intervention.

“It will also be possible for vehicles to connect with infrastructure. For example, if a light turned red, but an approaching vehicle failed to slow, perhaps because the driver was distracted, a warning could be issued or action taken to automatically control the vehicle.”

Professor Rakotonirainy said while these features had the potential to improve road safety, if hacked people's lives could be put at risk.

“If someone hacks into a vehicle's electronics via a wireless network and exploits the current security loophole, they can track or take control of it,” he said.

Professor Rakotonirainy said it was vital for car makers, government and road safety experts to turn their attention to this global security threat.

“We need to be analyzing the types of risk that that these intelligent vehicles are facing and work to provide a secure, reliable and trusted protection system,” Professor Rakotonirainy said.

“A vehicle's communication security over wireless networks cannot be an afterthought and needs to be comprehensively considered at the early stages of design and deployment of these high-tech systems from the hardware, software, user and policy point of view.”

### Is your Soul electric?



Kia Motors has brought out an electric version of its Soul crossover. The Soul EV features two standard charging ports, an SAE J1772 port for Level 1 and Level 2 AC charging, and a CHAdeMo DC fast-charging port (480 V). It can be charged to 80 percent in as little as 33 minutes with a 50 KW fast charger

(five hours using a 240 V outlet). Set to launch initially in California, the car will go on sale in additional select markets in 2015.

Energy comes from a 27 kWh, air-cooled, 200 Wh/kg lithium-ion polymer battery that provides an EPA estimated range of 93 miles, which the company says is better than all other EVs on the market except the Tesla Model S.

Other features include a regenerative braking system with four selectable drive mode combinations: “Drive” or “Brake” modes in Eco-mode “Off,” and “Drive” or “Brake” modes in Eco-mode “On” (the “Brake” or “B” setting with Eco-mode “On” producing the most regeneration).

The front-wheel drive vehicle is powered by a 109-hp (81.4 kW) electric motor, producing 210 lb.-ft. of instantaneous torque fed through a single-speed constant-ratio gear reduction unit. The liquid-cooled AC synchronous permanent magnet motor uses multi-layer magnets to help improve efficiency and reduce whine common to some other EVs. Acceleration from 0 to 60 mph is expected to take less than 12 seconds with top speed electronically limited to approximately 90 mph. The battery's location beneath the floor results in a lower center of gravity, which helps ride and handling and ensures that the EV remains true to the Soul's fun-to-drive reputation. Additional cross bracing beneath the low-mounted battery contributes to a 5.9 percent improvement in torsional rigidity over the gasoline-powered Soul and offers protection to the battery.

The starting manufacturer's suggested retail price, including destination charge, is \$34,500

### Ford Making Tesla-Like Vehicle?

*[From a CNBC story by James R. Healey dated Oct 24]*

“Ford CEO Mark Fields says the company has the expertise and ability to build a Tesla-style high performance, long-range electric vehicle.

“Fields stopped short of saying Ford will do so, but did say, ‘It's consistent with our product philosophy.’

“Fields made the comment Friday during a conference call with Wall Street investment analysts and reporters during a conference call following Ford's third quarter earnings announcement.

“Ford’s current electrics are small, and — typical of all non-Tesla electrics — have modest performance and driving range compared to the fast Model S that can run 250 miles or so on a charge.

“Ford said it has no plan to emulate the Tesla Model S. But a larger vehicle of some kind, with greater range and better performance, would fit Ford’s lineup and its emphasis on technology, the automaker said.

“In the conference call, Fields said Ford has the engineering and manufacturing sophistication to do such a model, with the range and quickness that characterize the Model S.

“Ford has a Tesla Model S and, Fields said, ‘We drove it. We took it apart. We put it back together and we drove it again.’”

## UTILITIES TRYING TO TAKE OVER SOLAR MARKET? By California Pete



I’ve written in the past about the problems that electric utilities have with the widespread use of solar energy. For one thing, they have to be able to provide as much power as the solar sources produce, but just keep it in reserve for when the sun fails to shine brightly enough. Also, they have to pay the solar producers, which cuts into their revenue. But some of the utilities have found a way to fight back, according to an October 25 article by David Baker in the *San Francisco Chronicle*, and the solar companies are displeased.

“In Arizona, the state’s largest utility has proposed leasing rooftops from its residential customers, installing solar arrays and paying the homeowners \$30 a month in return. If approved by state regulators, the plan would place Arizona Public Service in direct competition with Bay Area companies such as Sungevity, Sunrun and SolarCity that already lease panels to homeowners.”

Talk about a bad deal! At the moment there are two main ways to put in solar power. In one the homeowner puts nothing down, and pays a substantially discounted electric bill to the solar company, which keeps part of it and

pays the customer’s electric bill.

In the other scheme the customer pays for the panels up front and then pays a greatly reduced electric bill from then on.

My eldest son examined the alternatives and chose the second, taking out a home equity loan to have the panels installed and paying an essentially zero electric bill each month. He figures the panels will be paid for in about another year, and after that it will be all gravy.

So a 30 percent discount is a bad deal, unless you can’t pony up the capital for the initial installation. And it’s a blow to the solar companies, but that’s pretty much what the electric company had in mind, I guess.

But utility companies are not confining themselves to rooftop solar: PSE&G has started construction on a 10.14-MW solar farm on the capped Parklands Landfill, according to Briefing.com. “The project, part of PSE&G’s Solar 4 All program, will transform 40 acres of landfill space into a clean energy producing solar farm, capable of powering nearly 2000 average-size homes annually.”

## Whither oil prices?

The price of crude keeps falling, with the potential for good and bad results.

The good results are pretty obvious: less money spent on gas means more money available for buying other things (energy prices act as a direct tax on the economy as a whole, and on consumer demand in particular). And on the international scene, they hurt some pretty nasty folks, like the governments of Russia, Iran and Venezuela, among others. On the other hand, points out Sharon E. Burke in a November 7 column in *CNN Money* online, in countries with poor governments that are heavily dependent on oil revenues, continued low prices could lead to instability and even collapse; how much we should worry about this varies by country, but in general international instability is bad for U.S. security, Burke writes. The answer (with which I totally agree) is to greatly lessen the United States’ and other countries’ dependence on oil.

But of course that would have economic and political consequences here, as well.

## Is it too late to stop climate change?

The United States and China have taken

the first steps to agreement on reductions in greenhouse gas emissions, although the burden on China will be arguably much less than on the U.S. (China is still building a new coal-fired power plant every ten days). And climate change deniers have just gained considerable political power: a certain senior senator from Kentucky has been speaking out against what he perceives as a “war on coal, and has said that he will work to stop any legislation that would harm coal production.

All this is has happened against the background of the recent U.N. report on the importance of reducing carbon emissions, but there is good reason, as has been stated in this column before, to believe that it is too late: global warming is now irreversible. Mankind will not reduce carbon emissions in time, and planetary processes that add greenhouse gases to the air are moving ahead, from melting of the arctic tundra and the release of methane from decomposing vegetation, to breakdown of methane hydrates in the ocean.

We can’t stop it, and will have to learn to live with it. For many people in the West that will mean getting used to desert living, but as more and more farmland becomes useless, what will become of food production worldwide?

### **Anybody want a free crane?**

An important piece of equipment in the building of the recently-completed eastern section of the Bay Bridge was a massive crane called the Left Coast Lifter. “The crane has a boom length of 328 feet, can lift 1,900 tons and sits on a 384-foot barge,” according to the *San Francisco Chronicle*, and cost us \$50 million. So now that we no longer need it, what did we do with it? We gave it, free of charge, to the main contractor on the project (we must admit that this was written into the original contract). After a lengthy sea voyage, the crane is now in the Hudson River, working on the reconstruction of the Tappan Zee bridge.

So if you’re heading north from New York City, the big crane you’ll see (now renamed the I Lift NY super crane) comes courtesy of Bay Area toll payers.

## **COMING EVENTS**

### **Challenge Bibendum China 2014**

Nov 11 to 16, 2014, Chengdu, China. [www.challengebibendum.com/eng/event/china-2014](http://www.challengebibendum.com/eng/event/china-2014)

### **2014 North American NGV Conference & Expo**

November 11-14, Kansas City. [www1.eere.energy.gov/cleancities/events\\_detail.html?event\\_id=8692](http://www1.eere.energy.gov/cleancities/events_detail.html?event_id=8692)

### **SAE 2014 Electric Powertrain Technologies Symposium**

November 19, Stuttgart, Germany. [www.sae.org/events/epts/](http://www.sae.org/events/epts/)

### **CALSTART Annual Meeting and Blue Sky Award Luncheon**

Dec 9, Los Angeles. [www.calstart.org/events/calstart-events/99-07-03/CALSTART\\_Annual\\_Meeting\\_and\\_Blue\\_Sky\\_Award\\_Luncheon.aspx?Events=EventItem](http://www.calstart.org/events/calstart-events/99-07-03/CALSTART_Annual_Meeting_and_Blue_Sky_Award_Luncheon.aspx?Events=EventItem)

### **SAE 2015 Hybrid & Electric Vehicles Technologies Symposium**

February 10-12, 2015, Los Angeles. [www.sae.org/events/hybridev/](http://www.sae.org/events/hybridev/)

### **SAE Clean Snowmobile Challenge**

March 2-7, Houghton, MI. <http://students.sae.org/cds/snowmobile/event/>

### **SAE 2015 World Congress & Exhibition**

April 21-23, Detroit. [www.sae.org/congress](http://www.sae.org/congress)

### **2015 World Solar Challenge**

October 6-13, Australia. Go to <http://www.worldsolarchallenge.org>

## **MEETING SCHEDULE**

Meetings are held in Room 49, Plymouth-Whitemarsh High School, 201 East Germantown Pike in Plymouth Meeting, PA, and begin at 7:00 p.m.

December 10

January 14

February 11

March 11

April 8