Press Release 14/2015

Ulm, October 12, 2015

Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (ZSW)

Standort Ulm:
Helmholtzstr. 8, 89081 Ulm

High-Energy and Affordable Batteries for Electric Vehicles

ZSW develops new cobalt-free cathode material for lithium-ion cells

Scientists at the Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW) have developed an exciting newly-engineered cathode material for high energy lithium ion batteries. This material, lithium nickel manganese oxide, achieves up to 40 percent higher energy density than conventional cathode materials. It is produced with comparatively low nickel content and the need of expensive raw materials such as cobalt is eliminated. Importantly, the material has been engineered to be suitable for large-scale production. With this innovation, the development of a safe and affordable high energy lithium ion battery for electric vehicles is within reach. ZSW is now seeking development partners for future material and cell production.

Lithium nickel manganese oxide $Li_{1+x}Mn_{1.5}Ni_{0.5}O_4$ provides more than 210 milliampere hours per gram (mAh g^{-1}) storage capacity surpassing that of conventional cathode materials in use or currently in development. The high energy density increase of up to 40 percent can be achieved due to the high operating voltage of over 4.5 V. Batteries with such an improvement in energy density allow a significant increase in range for electric vehicles.

$Li_{1+x}Mn_{1.5}Ni_{0.5}O_4$ provides additional advantages. The thermal stability of the cell in a charged state is greatly improved as compared to conventional cathode materials. This leads to a significant improvement in battery safety. Preliminary results of battery lifetime are also optimistic. Even though at an early stage of the development, 150 cycles without any capacity loss could be demonstrated for complete cells consisting of graphite as anode material.

Lithium nickel manganese oxide can be easily produced with well-known in-house manufacturing processes. Scientists at ZSW have already delivered high quality samples on a kilogram scale. The powder consisted of spherical particles with a high tap density of 2.4 grams per cubic centimeter (g cm^{-3}). The particle size is comparable to those of conventional cathode materials and therefore can be easily implemented into commercial electrode-coating processes.

“Our cobalt-free lithium nickel manganese oxide is a very promising innovative material for lithium-ion batteries used for electric vehicles”, according to Dr. Margret Wohlfahrt-Mehrens, Head of the

Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (ZSW)

Standort Ulm:
Helmholtzstr. 8, 89081 Ulm

Accumulators Materials Research Department at ZSW. “Capacity and energy density are higher, cost is reduced and large-scale production is possible.”

State of the art cathode materials for lithium-ion batteries consist of nickel and cobalt layered oxides such as NCM (1:1:1), NCA or NCM (8:1:1) currently being developed. Raw materials such as cobalt, however, are expensive and in limited supply. Reducing the nickel content is also beneficial in reducing cost. The newly developed cathode material eliminates these disadvantages in addition to improving performance, lifetime and battery safety for electric vehicles.

The use of batteries for mobile applications is strongly increasing. Revenues for 2014 were over two billion Euros. The growth of the market is expected to expand, reaching a projected 15 billion Euros per year in 2020. However, the real growth will begin after 2020 with the vast market penetration of electric vehicles. For battery material manufacturers, this strong growing market is of great interest. For the upcoming battery demand, the availability of raw materials must be considered. Cobalt which is currently used in conventional cathode materials, is not only a rare element, but also subject to geopolitical interests.

ZSW's research was funded by the Federal Ministry of Education and Research as part of an Excellent Battery Initiative called the LiEcoSafe project. Its funding code is 03X4636A.

The Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW) is one of the leading institutes for applied research in the fields of photovoltaic energy, renewable fuels, battery technology, fuel cells and energy systems analysis. The three ZSW sites at Stuttgart, Ulm and Widderstall are currently staffed with around 230 scientists, engineers and technicians supported by 70 research and student assistants.

Media contacts

Tiziana Bosa, Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (ZSW), Helmholtzstr. 8, 89081 Ulm, +49/731/9530-601, Fax: +49/731/9530-666, tiziana.bosa@zsw-bw.de, www.zsw-bw.de

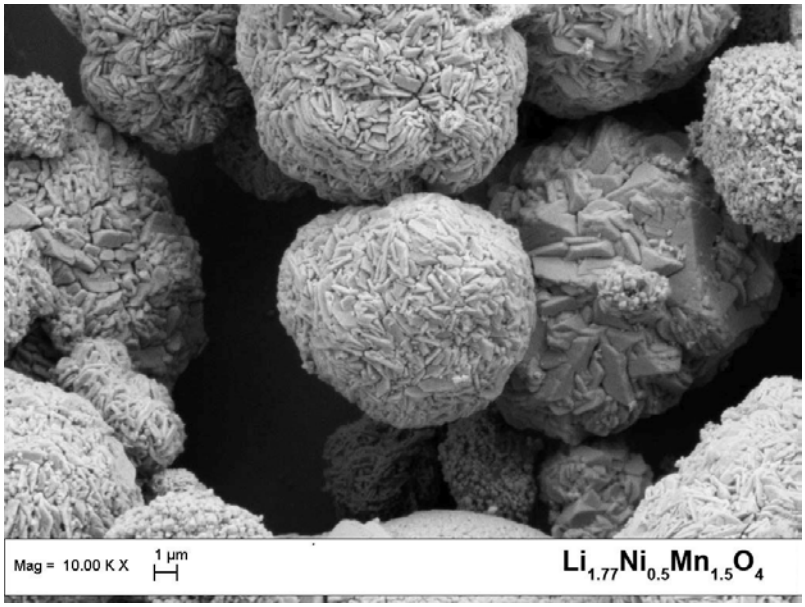
Axel Vartmann, PR-Agentur Solar Consulting GmbH, Emmy-Noether-Str. 2, 79110 Freiburg, Tel.: +49 (0)761 380968-23, Fax: +49 (0)761 380968-11, vartmann@solar-consulting.de, www.solar-consulting.de

Pictures and a fact sheet on ZSW is available from:

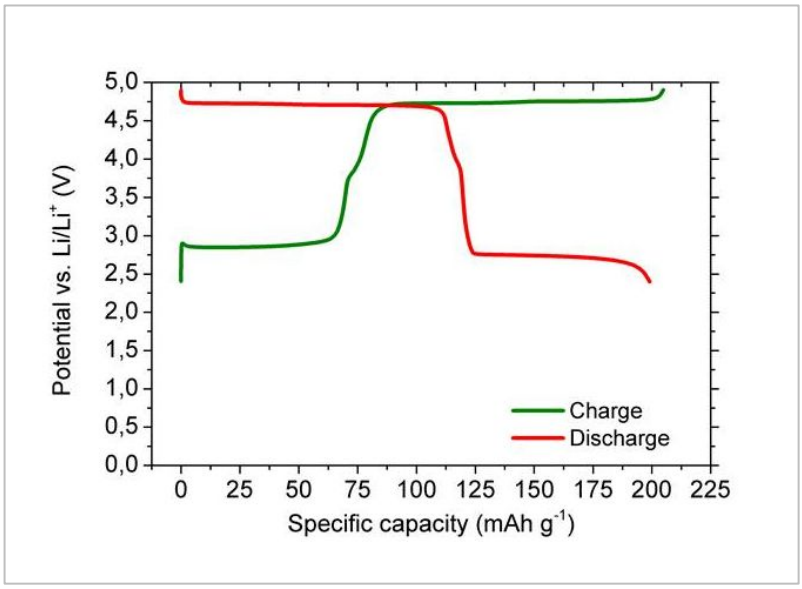
Solar Consulting GmbH

Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (ZSW)

Standort Ulm:
Helmholtzstr. 8, 89081 Ulm



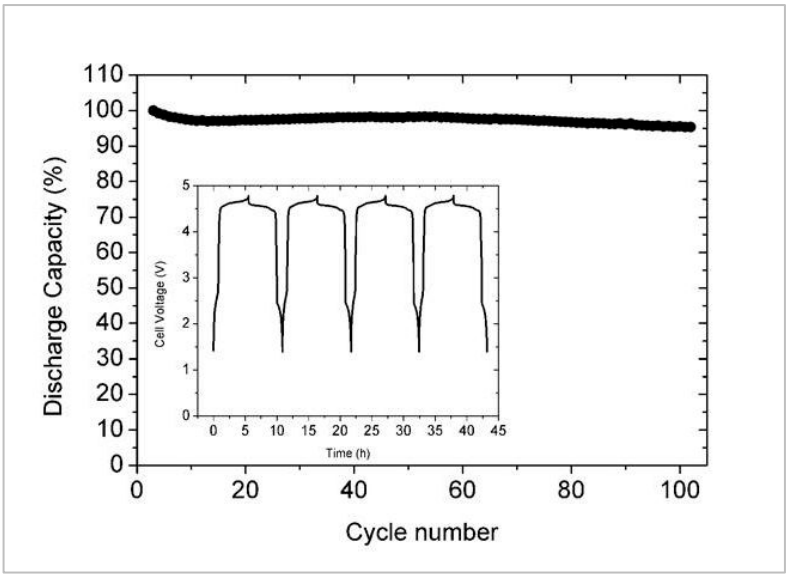
SEM of powder particles of cathode powder. Photo: ZSW



Charge/Discharge curve for cathode material ($Li_{1.77}Mn_{1.5}Ni_{0.5}O_4$). Diagram: ZSW

Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (ZSW)

Standort Ulm:
Helmholtzstr. 8, 89081 Ulm



Cycling stability of Li ion full cell with new cathode material; Charge/discharge profile of cell (insert). Diagram: ZSW