Fraunhofer IWS

FRAUNHOFER-INSTITUT FÜR WERKSTOFF- UND STRAHLTECHNIK IWS

PRESS RELEASE

Key component for batteries of the future

Fraunhofer IWS is developing innovative solutions for current challenges of lithium metal anodes

(Dresden, April 3, 2019) Fraunhofer IWS scientists headed by Dr. Holger Althues have developed an innovative process for the cost-efficient production of thin lithium anodes made of molten lithium. In the BMBF-funded "MaLiBa" project, the Dresden Institute is working with the companies hpulcas and SGS as well as with scientists led by Prof. Dr. Jürgen Janek of the Justus Liebig University in Giessen to solve further crucial issues relating to this concept. The most important innovation consists in realizing an anode compound. This contains a few micrometers thick nickel foil with lithium film stabilized by means of protective layers.

Lithium-metal anodes are regarded as key elements for battery systems of the future. They enable the energy density to be maximized both in terms of cell volume and mass. The lithium metal anode is already being used in lithium sulfur cells to achieve record specific energy values of more than 400 watt hours per kilogram. By comparison, the best lithium-ion battery cells currently only achieve 250 watt hours per kilogram. In addition, solid state batteries could exceed the volumetric energy density of today's lithium-ion batteries by more than 70 percent using the lithium metal anode. Conventional production solutions for lithium foils include rolling processes. Their disadvantage is the fact that the production of films with less than 50 micrometers over large areas is very challenging. The quality is also limited, as auxiliary materials or lubricants chemically contaminate the surface. Thus lithium foils cannot be produced on an industrial scale with the quality requirements necessary for battery applications. In addition, production technologies for high-quality and thin lithium coatings are not yet commercially available and the interface between lithium and other cell components is highly reactive. This in turn requires interface engineering to enable stable and safe use of the lithium anodes.

The project upon which this report is based was funded by the Federal Ministry of Education and Research under the number 03XP0185. Responsibility for the content of this publication remains with the author.

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

Lithiophilic current collector surface enables lithium melt wetting

For several years now, the Fraunhofer IWS has been working on a coating process that permits producing lithium films with just a few micrometers thickness. The most important innovation involves a lithiophilic surface that allows cost-effective and

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homogeneous deposition of molten lithium's thin coatings on metallic substrates. "We are able to process thin nickel and copper foils in such a way that it becomes possible to coat them by liquid (molten) lithium," explains Dr. Holger Althues, head of the Department of Chemical Surface and Battery Technology at Fraunhofer IWS. Since spheres form when liquid lithium is applied to an untreated copper or nickel foil, it is not possible to wet the foil surface with lithium. "However, this is absolutely necessary in order to create a coating, and we are able to achieve this with a lithiophilic substrate surface," Dr. Althues concretizes. Further advantages include the fact that the developed IWS technology could be implemented at particularly low cost and could already be scaled up to industrial standards in the roll-to-roll process. Modifications of the lithium surface are intended in order to enhance this coating process within the "MaLiBa" project. The project team, coordinated by IWS, aims at significantly improving the handling, stability and safety of lithium anodes for use in battery cells. This research will be complemented by developing a laser cutting process within the "LiMeCut" project, which will enable flexible cutting of lithium anodes. The result will be a toolbox for adapting anodes to customer-specific cell systems and formats. "We see a growing demand in the development of lithium metal batteries," explains battery researcher Dr. Althues. "Already today we can meet many requirements by fabricating tailor-made anodes."

About MaLiBa and LiMeCut

In the joint project "Tailored Metal Anodes for Future Battery Systems" (MaLiBa) Fraunhofer IWS in cooperation with the Justus-Liebig-University Gießen, the companies hpulcas and the SGS develops customized and surface-modified lithium anodes for batteries of the future, while the "LiMeCut" project (funded by the German Federal Ministry of Education and Research as part of the eurostars program under funding code 01QE1837) in cooperation with OxisEnergy and ULT focusses on developing a flexible laser process technology for cutting lithium anodes. Initial project results will be presented at the "Lithium Metal Anodes" conference in Dresden in November as part of an all-day program with contributions by international experts from science and industry.

Find more about the battery of the future: Two days, two workshops! On November 18 and 19, 2019, the Fraunhofer IWS will host the "Carbon Electrode Materials" and the "Lithium-Metal-Anodes: Processing and Integration in Next-Generation Batteries" in Dresden. More information coming soon at http://s.fhg.de/iws-events.

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Lithium coating on copper foil created by IWS melt deposition: The process already permits producing prototype cells with lithium anode layers of 5 to 30 micrometers in thickness.
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Prototypes of next-generation battery cells are being developed at Fraunhofer IWS. In the "MaLiBa" project scientists use generic lithium anode technology for lithium-sulfur batteries with high volumetric energy density.
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The **Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS Dresden** stands for innovations in laser and surface technology. As an institute of the Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e. V., IWS offers one stop solutions ranging from the development of new processes to implementation into production up to application-oriented support. The fields of systems technology and process simulation complement the core competencies. The business fields of Fraunhofer IWS include PVD and nanotechnology, chemical surface and reaction technology, thermal surface technology, generation and printing, joining, laser ablation and separation as well as microtechnology. The competence field of material characterization and testing supports the research activities.
At Westsächsische Hochschule Zwickau, IWS runs the Fraunhofer Application Center for Optical Metrology and Surface Technologies AZOM. The Fraunhofer project group at the Dortmunder OberflächenCentrum DOC® is also integrated into the Dresden Institute. The main cooperation partners in the USA include the Center for Coatings and Diamond Technologies (CCD) at Michigan State University in East Lansing and the Center for Laser Applications (CLA) in Plymouth, Michigan. Fraunhofer IWS employs around 450 people at its headquarters in Dresden.