Press release

Production technology for solid-state batteries

In a research project funded by the state of Baden-Württemberg with more than one million euros, researchers at the IPA are now working with the medium-sized companies Dr. Fritsch Sondermaschinen GmbH and Dr. Fritsch GmbH & Co KG to develop the process technology for the solid-state batteries of the future.

"Solid-state batteries have the potential to replace current battery technology," Carsten Glanz is convinced. Together with a team of scientists and two medium-sized companies from Baden-Württemberg, the group leader for application technology of functional materials at the Fraunhofer Institute for Manufacturing Engineering and Automation IPA wants to create the conditions for the automated production of high-quality electricity storage devices.

Compared with the lithium-ion batteries commonly used today, solid-state batteries have several advantages: Safety is higher - because no liquid electrolyte is needed, nothing can leak and ignite. They also have a higher energy density and a longer lifetime.

The technology is still in its infancy. "Solid-state batteries with an electrolyte layer made of ceramic, for example, have so far only been manufactured on a laboratory scale. Scalability - that is, transferring the results to large-scale production - is still completely unclear," explains Glanz.

In the project "Erforschung neuer Misch- und Sintertechnologien für gradierte keramische Festkörperelektrolyte" (EMSig; english title: "Research in new mixing and sintering technologies for graded ceramic solid-state electrolytes"), the engineer now wants to work with two industrial partners to develop and optimize a process chain for the large-scale production of batteries with ceramic solid-state electrolytes. "At the IPA, we have a lot of experience with automation in battery production through the Center for Battery Cell Manufacturing, and our cooperation partners have in-depth expertise in the production and functionalization, handling and sintering of powders."

"Dr. Fritsch GmbH & Co KG will provide and modify the ceramic starting powder needed for the production of ceramic electrolytes," informs Ute Wilkinson, managing director at Dr. Fritsch. "Here we have the expertise to produce and analyze tailor-made materials." The second partner is Dr. Fritsch Sondermaschinen GmbH, a leading international manufacturer of machines for mixing, dosing and sintering of powders. The company has a long tradition in innovative powder handling and sintering technology. This means that new production methods can be immediately implemented in the required machines. The focus of the production process will be on the further development of innovative FAST/SPS sintering systems. With more than 1000 installed sintering systems, Dr. Fritsch is the world's leading manufacturer of such FAST/SPS machines. The EMSig project is supported by the state of Baden-Württemberg with 1.164 million euros.

Smooth transition instead of rigid boundary

A particular challenge in the production of solid-state batteries are the material transitions: sharp interfaces between the individual layers of the battery can lead to poor ion conduction. Different thermal expansions can even cause fracture along the interfaces.

The solution: smooth transitions. "We know from laboratory experiments that the stresses can be prevented by gradual transitions between the ceramic solid-state electrolyte and the electrodes," reports Glanz. "However, it was previously unclear how these stress-reducing transitions could be realized in terms of process technology."

The goal of the EMSig project is to build a demonstrator system in which solid-state batteries are built up and sintered layer by layer from ultra-thin, homogeneous powder layers, with the composition of the powder changing with each

layer: At the transition between electrode and electrolyte, for example, successively more ceramic powder is added - 25, 50, 75 and finally 100 percent.

In two years, the entire production process should be mature enough to be used by industry for large-scale battery production.

Profile

Project: »Research in new mixing and sintering technologies for graded ceramic solid-state electrolytes (EMSig)«

Project partners: Dr. Fritsch GmbH & Co KG, Dr. Fritsch Sondermaschinen GmbH, Fraunhofer Institute for Manufacturing Engineering and Automation IPA

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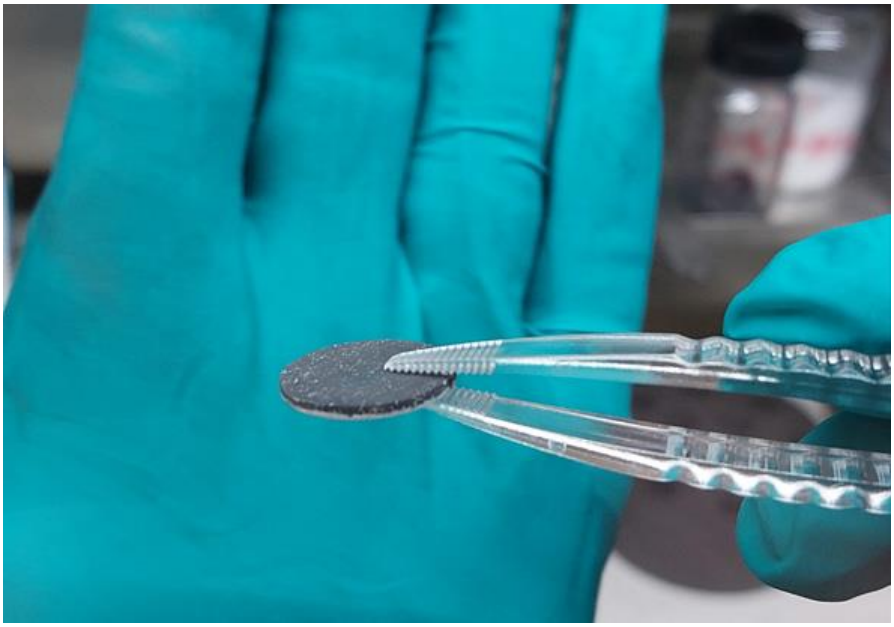

Multilayer, ceramic solid-state cathode for initial functional tests. Source: Fraunhofer IPA / Photo: Inga Landwehr