Fraunhofer FEP

FRAUNHOFER INSTITUTE FOR ORGANIC ELECTRONICS, ELECTRON BEAM AND PLASMA TECHNOLOGY FEP

THIN-FILM PRODUCTION TECHNOLOGIES FOR ENERGY STORAGE MEDIA

Li IONS AND LiS BATTERIES, THIN-FILM BATTERIES, AND CAPACITORS

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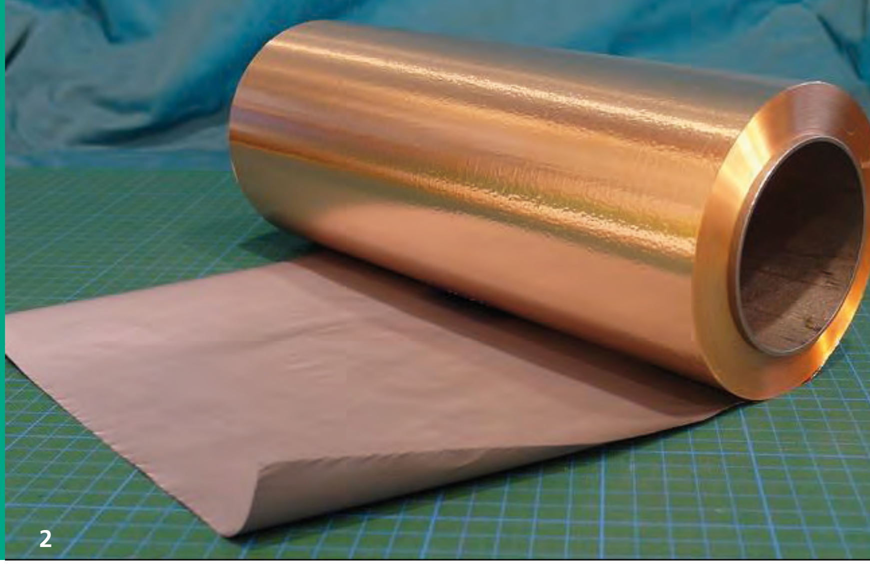

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Initial situation

Our mobile communication capabilities are determined to a great extent by the performance of energy storage media. Research groups worldwide are working on solutions for mobile devices as well as for stationary energy storage media – which on the one hand are intended to increase the energy densities of these systems, and on the other their safety. These developments involve the continual improvement of conventional technologies as well as the invention of new designs such as lithium-sulfur and all solid-state cells, for example. Thin films play an increasingly important role in solving boundary layer problems as well as in the manufacture of active components for cells.

What we offer

Fraunhofer FEP has developed and continuously refined its know-how in the area of surface technologies. These include in particular roll-to-roll vacuum processes and high-rate electron-beam evaporation techniques for various applications involving large surface areas. These processes are currently being employed for development of energy storage media. Fraunhofer FEP offers its clients the opportunity of testing these processes in the lab as well as at pilot-plant scales. Technology transfer to industry is assured by partnerships with equipment manufacturers and scientific institutions. Fraunhofer FEP is a member of the Fraunhofer Battery Alliance:

www.batterien.fraunhofer.de/en

Current research priorities

Fraunhofer FEP is also involved in Lithium- and Post-Lithium-Technologies projects. We are developing vacuum-based thin-film technologies for use as the interface for battery cells as well as complete operative substrates in this project.

Fraunhofer FEP is developing production-oriented roll-to-roll processes as part of the LiScell project for manufacturing silicon anodes having an especially advantageous morphology. Their potential impact on attainable energy densities stands out in comparison to graphite anodes. State-of-the-art development enables Fraunhofer FEP to apply a double-sided layer of silicon roll-to-roll on copper foil as thin as 6 µm and able to achieve area capacitance density of 2 ... 3 mAh/cm².
www.liscell.fraunhofer.de/en

The research areas of the Post-Lithium Technologies project at Fraunhofer FEP also incorporate advances in the deposition of solid-state electrolyte layers with the emphasis directed toward mass production deposition processes.

Moreover, Fraunhofer FEP developed anti-corrosion layers on aluminum foil cathodes, leading to pilot-scale production of these components. Fraunhofer FEP offers these capabilities to industrial partners through bilateral and government-funded research projects.

To summarize, Fraunhofer FEP utilizes its in-house expertise for the advancement and optimization of battery technologies to achieve higher capacities, enhanced cycle stabilities, and considerably lower production costs.


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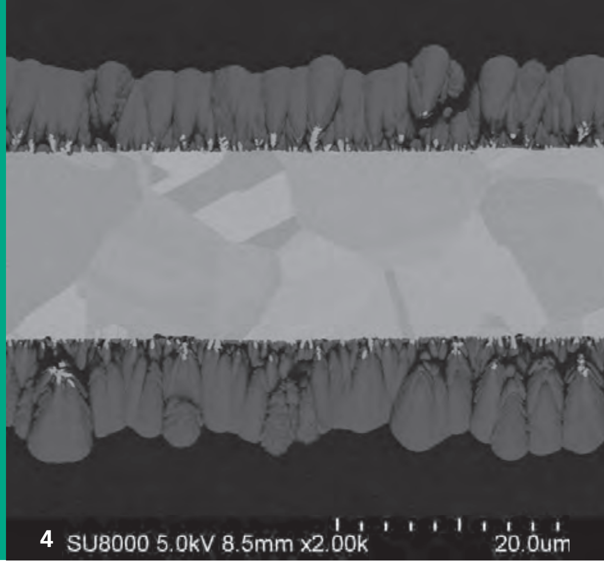

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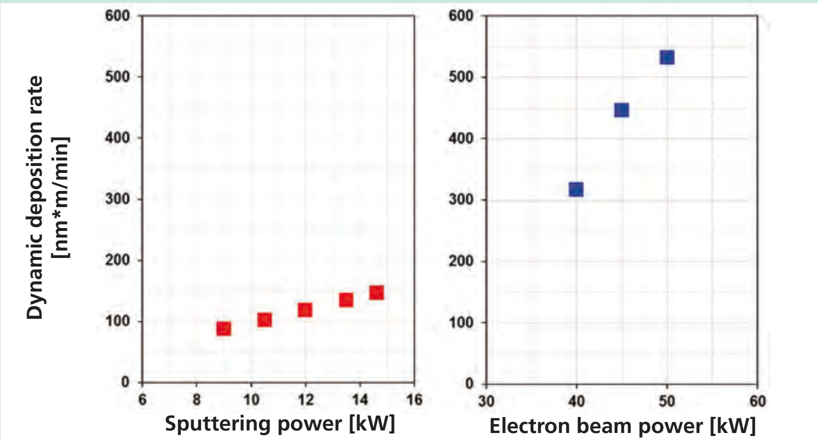
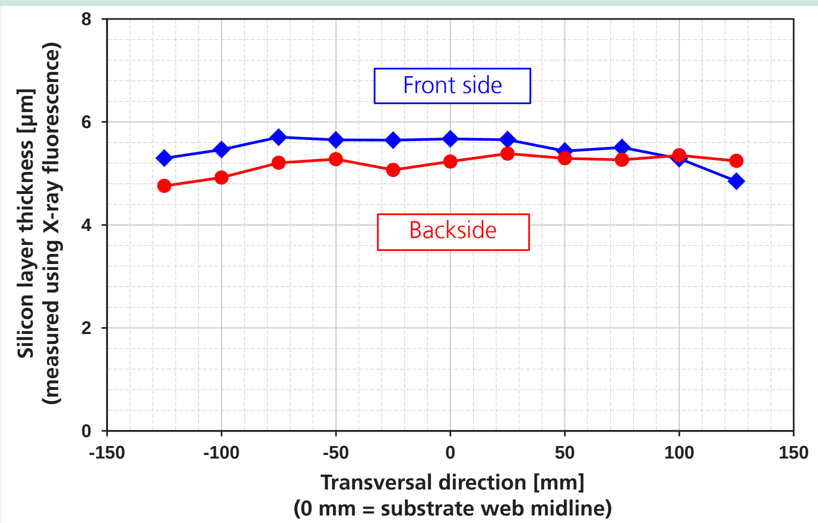
Experimental equipment

Development takes place largely in the Fraunhofer FEP *novoFlex® 600* pilot plant (Fig. 3). It has been used to create silicon anodes with an electrical current capacity of up to 3 mAh / cm² for example, and displays the following additional properties:

5 Silicon deposition rates achievable with magnetron sputtering and electron beam evaporation



6 Cross-sectional distribution of silicon layer thickness as applied by electron beam evaporation



COVER PICTURE

Display showing the layers of a battery

1 *PET film coated with copper*

2 *Copper film with double-sided coating of silicon applied in a roll-to-roll process*

3 *novoFlex® 600*

4 *Morphology of silicon layers*

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