Development of foam-based 3D-electrodes for high power all-solid state batteries

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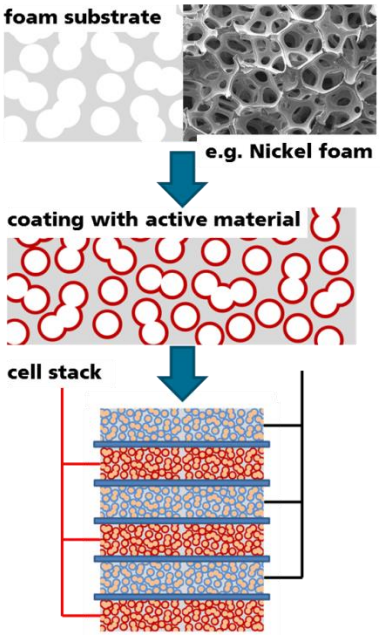
Conventional lithium ion battery concepts are based on two-dimensional electrode structures. They usually comprise electrodes consisting of active material layers deposited on metallic foils that are stacked together with polymer-based separators and soaked with liquid electrolyte.
The concept presented here in contrast makes use of three-dimensional, foam-based structures as substrates for the deposition of the active material layers. The large inner surface of the foams leads to a drastical increase of the available surface area for ion exchange. This allows for high power applications, even when the ionic conductivity of the electrolyte is limited, as is the case for many solid-state electrolytes. Because of the high porosity of the foams of 95% and above, the volumetric energy density can still be kept at a high level in this concept.



The research presented here reports the development of novel three-dimensional, foam-based electrodes for application in Lithium-ion batteries with liquid or all-solid state electrolytes. By their specialized design, these electrodes are capable of delivering both high power and high energy. Requirements for the foam design are derived from application demands. Next, the foam substrates are coated with active material layers and assembled into cells for proof of concept. Different coating concepts and the impact of pore size and foam material are evaluated. An outlook on all-solid state battery concepts extending the liquid-electrolyte approach is given as well.

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