

Modeling and Simulation of the Coating Process on Open Porous Metal Foams

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Due to an increasing demand of energy and raw materials, resources should be used efficiently. Therefore, multifunctional materials and lighter constructions are needed, which can endure higher payloads. Cellular materials like metal foams are bionic materials consisting of nodes and struts. By a coating of the foam structure, the material properties per unit mass can be optimised. The metallic coating is done by electrodeposition. In consequence of the mass transport limitation inside the foam, there is an inhomogeneous coating thickness. To get a homogeneous coating thickness, in this project the factors influencing the electrochemical coating process are studied and simulated based on a coupled material model.

The electrodeposition process can be described by an ion source at the anode, the mass transport from anode to cathode and an ion sink at the cathode. The Forchheimer-extended Darcy equation is used to model the velocity distribution in the foam. The mass transport and the deposition process are characterised by the continuity equation with convection, diffusion, migration and a sink term.

In this project the factors influencing the coating thickness are investigated by numerical simulation to provide a homogeneous coating thickness. A material model coupling mass transport with electrodeposition is developed. A finite difference approach was used to simulate the velocity and the ion concentration distribution inside the foam. A one-sided coupling of the Darcy equation with the continuity equation is already considered. Different velocities, diffusion constants and linear deposition rates are studied by the simulation.