Through-process multiscale modelling of Aluminum sheet production

T. Brüggemann[*,1], K.-F. Karhausen[1], M. Loeck[2]

[1]Hydro Aluminium Rolled Products GmbH, Research & Bonn

[2]Institute of Physical Metallurgy and Metal Physics, RWTH Aachen, University

During the conventional production of aluminum sheets from cast ingots, the workpiece passes through a sequence of rolling and annealing steps. This thermomechanical treatment is utilized to achieve favored final properties of the semi-finished product. During production, the process influences the microstructure, i.e. via deformation and heat input the texture, grain size, and other microstructural characteristics develop. Thus, the resulting properties of the workpiece are altered throughout the process.

If this production route is mapped computationally via integrated process and microstructure simulation tools, there is a high potential for optimizing microstructural and final properties and the process itself. Furthermore, the utilization of such a simulation setup gives the possibility to gain understanding of complex interactions within the system, which might not be able to be tracked experimentally.

In a collaborative project with RWTH Aachen university, existing process models (by Hydro Aluminium Rolled Products, R&D Bonn), and physically based microstructure models (developed at the Institute of Physical Metallurgy and Metal Physics, RWTH Aachen University) were coupled. Within the web-based simulation platform SimWeb@IMM, interfaces and several additional modules have been implemented to interlink these models. Thus, a fully automated simulation framework has been realized, which is capable to calculate the evolution of appropriate process and microstructural state variables over the course of various complete multi-pass rolling chains.

Focus will be put upon the setup of the framework and its application. Furthermore, case studies will be shown in which the microchemistry state has a strong influence on the evolution of microstructural variables and thus on the resulting properties.