Automated Process Simulation with Microstructure Integration for Aluminium Sheet Rolling

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ABSTRACT

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 favoured final properties of the semi-finished product. In the course of 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 aforementioned 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 this work existing process models (namely *ROSERoll* and *ROSEAnneal*, by Hydro Aluminium Rolled Products, R&D Bonn), and physically based microstructure models (*3IVM+*, *GIA* and *CORe*, developed at the Institute of Physical Metallurgy and Metal Physics, RWTH Aachen University) were used. 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.

Simulated microstructure evolutions generated via this framework show good agreement with experimental observation for the considered alloys of both AA5xxx and AA8xxx series. Focus will be put upon the numerical implementation, microstructure discretization, parametric studies (i.e. influence of an altered starting temperature), and the experimentally validated simulation of process routes with partially recrystallized microstructures.