# Microstructure-based Multiscale Analysis of Hot Rolling of Duplex Stainless Steel by using Various Simulation Software

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## ABSTRACT

Microstructure-based multiscale simulation of hot rolling process of duplex stainless steel was performed by using molecular dynamics, multi-phase-field, crystal plasticity and finite element simulation software. Microstructure evolution during continuous casting of duplex stainless steel was simulated by three-dimensional multi-phase field simulation software coupled with CALPHAD (Thermo-Calc) database: MICRESS. In order to simulate equiaxed and columnar solidifications in the inner region and on the surface of a slab, two different cooling temperature profiles were used. The simulated microstructures were composed of FCC and BCC phases and the elastic constants of each phase were estimated by molecular dynamics simulation using LAMMPS. Also, the homogenized elastic properties of the equiaxed and columnar solidificated microstructures were calculated by HOMAT, which was based on the asymptotic expansion method. On the basis of the estimated elastic properties, the plastic flow curve of the BCC + FCC two-phase material were derived by numerical tensile test using the crystal plasticity simulation software: DAMASK. Furthermore, the plastic flow curves of the materials containing the equiaxed and columnar microstructures were calculated from a virtual material test using ABAQUS with HOMAT-ABAQUS interface module. Finally, microstructure evolution during dynamic recrystallization was simulated using MICRESS. The results obtained in this study demonstrated that the multiscale simulation using various software enables us to analyse the microstructure evolutions and the elastoplastic deformation behaviors in the duplex stainless steel reasonably.

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