Contribution to the modeling of primary recrystallization of IF steels. Experimental study and simulation

Abstract

This work is a contribution to the quantification and simulation of primary recrystallization in IF steels. IF steels are alloys with high drawing capacity and are intended for the automotive industry. To do this, we followed the evolution of the microstructure and the texture during recrystallization using an original combination of two criteria, GOS (Grain Orientation Spread) and normalized GOS (GOS/D) for grain detection. recrystallized from experimental maps obtained by EBSD (Electron Back Scattered Diffraction). The grain size distributions of the different stages of recrystallization and the evolution of the average size of recrystallized grains showed the existence of two regimes of microstructural evolution: up to about 50% recrystallization, the growth of new grains in the deformed matrix is the most dominant mechanism whereas beyond 50%, growth competition between recrystallized grains becomes the most dominant. During the first regime, the γ fiber strengthens slightly with a homogeneous distribution of intensity along this fiber. However, the texture is reinforced with the appearance of some peaks along the γ fiber during the second regime. The simulation is designed from the parameters deduced from the experimental study and its results are compared to the real evolution where an experimental cartography is used for the initiation of the simulation and for the implantation of the seeds according to a criterion based on KAM (Kernel Average Misorientation). The evolution of the simulation texture produces the same characteristics of the experimental one, however the evolution of the grain size and the grain size distribution is a little different for the advanced states of recrystallization. The incorporation of a differentiated stored energy and strong assumptions on grain boundary mobility, while taking advantage of the growth competition mechanism between recrystallized grains beyond 50% recrystallization can improve the simulation results.

Keywords : IF steel, recrystallization, EBSD, detection of recrystallized grains, GOS, stored energy, KAM, simulation Monte Carlo, microstructures, texture.