Secondary Recrystallization Mechanism in Heavily Cold rolled Grain-Oriented Silicon Steel

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Abstract

Two orientations ({110} and {110}) evolve as secondary grains in heavily cold rolled reduction of 91.5% in grain-oriented silicon steel. We investigated secondary recrystallization mechanisms of these two grains by temperature gradient batch annealing method. This method causes secondary grains to grow continuously along the temperature gradient direction and selective growth behavior can be easily observed from macrostructure and relationships of orientations of secondary grains and matrix grains. Both {110} and {110} grains statistically had a high frequency of effective CSL boundaries (more than 13%) and CSL boundaries corresponding to each orientation of secondary grains disappeared preferentially at growing fronts of each secondary grain. It can be deduced that CSL boundaries dominate the selective growth behavior of {110} and {110} grains, which have two or more neighboring CSL boundaries to the matrix and successively grow as secondary grains. CSL boundaries are considered to have lower grain boundary energy. Therefore, CSL boundaries suffer lower pinning forces from inhibitors and start to migrate from higher inhibition level (lower temperature). From these results, CSL boundaries play a dominant role of the selective growth in heavily cold rolled grain-oriented silicon steel.

Keywords: secondary recrystallization, selective growth, grain growth, grain, oriented silicon steel, CSL boundary

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