Role of grain boundary energy on particle dissolution induced abnormal grain growth

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Abstract

Despite decades of research, there is no agreement on the mechanisms contributing to the abnormal growth of $\{110\}\langle001\rangle$ oriented Goss grains in Fe-Si electrical steels. Recently, it was shown that preferential dissolution of second-phase particles on the grain boundaries (GBs) near Goss grains leads to depinning and consequent abnormal growth. Careful analysis of microstructures from experimental results in Fe-Si steels and other materials indicates the presence of curved GBs surrounding the abnormally growing grain. We use a higher order phase field model to study the role of selective particle dissolution and GB energy differences on abnormal grain growth and concomitant morphology. The simulation results indicate that low-energy GBs around abnormal grains are necessary to develop the curved GB morphology while AGG primarily occurs by preferential dissolution of the particles. The low energy GBs significantly enhance the kinetics of abnormal growth, consistent with experimental results reported in the literature.

Keywords: Abnormal grain growth, Fe, Si steel, Phase field model, Second phase particle, Grain boundary energy

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