Orientation dependence of dynamic compared to static recovery in Interstitial Free steel

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Abstract

The rolling process typically results in steel sheets with an α-(< 110> //RD) and γ-(< 111> //ND) fiber texture. This texture is commonly associated with cold rolling and is also observed in warm rolling. Despite the similarities in deformation textures, the evolution of recrystallization texture during annealing shows distinct differences. The recrystallization texture of cold-rolled is frequently characterized by the γ-fiber. In contrast, the recrystallization textures of warm-rolled traditionally contain components of the
theta-fiber (< 001> //ND), with peak intensity near the {001} < 110> component. This study delves into the behavior of local misorientations in the (sub)-structure of interstitial-free steel under three conditions: cold rolled (80% reduction), statically recovered (80% cold rolled, annealing at 600∘C for 120 s), and dynamically recovered (80% warm rolled at 550 ∘C). The misorientation gradient (
theta/x) was employed to assess local stored energy. < 111> //ND grains exhibit significantly higher misorientation gradient than < 001> //ND grains under all conditions. Both < 001> //ND and < 111> //ND grains display a drop in
theta/x of > 40% for the dynamically recovered state compared to the cold-rolled state. However, it is observed that the
theta/x of the statically recovered condition still exceeds that of the < 111> //ND grains by _˜14% and the < 001> //ND grains by _˜30% in the dynamically recovered state. The gradient difference between < 111> //ND and < 001> //ND grains is more pronounced in the cold-deformed and statically recovered samples than in the dynamically recovered samples. These quantitative results clearly reveal differences in the initial substructure at the onset of recrystallization and producing differences in recrystallization textures after cold and warm rolling.

Keywords: Local misorientation, Deformation process, Microstructural analysis, Misorientation gradient, EBSD, IF Steel, Texture

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