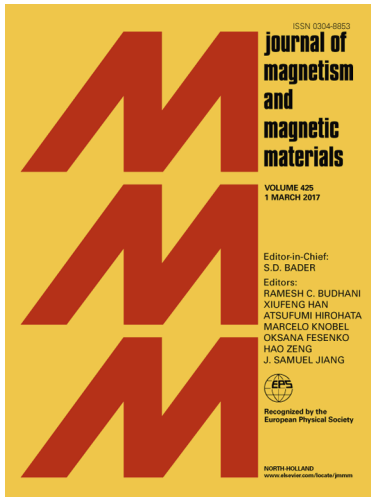

Research articles

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Magnetic properties of a 17.6Mn-TRIP steel: study of strain-induced martensite formation, austenite reversion, and athermal α'-formation

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Abstract

Strain-induced martensite (SIM) formation was evaluated upon cold-rolling of a 17.6wt.%Mn-TRIP steel by means of magnetic measurements, X-ray diffraction, and high-resolution electron backscatter diffraction (EBSD). α'-martensite formation was observed to be dependent on the presence of prior ε-martensite. Upon deformation, the coercivity of the ferromagnetic α'-martensite is characterized by strong magnetic shape anisotropy. Austenite (γ) reversion was evaluated by means of *in situ* magnetic measurements during continuous annealing. The experimental results were compared to thermodynamic simulations. It turned out that γ-reversion was not completed in the regime where a γ-single phase field is expected, which suggests the splitting of α' → γ transformation into two stages. The Curie temperature of remaining α'-martensite was determined as being ~ 620°C. Magnetic properties presented an annealing time-dependence within the temperature range of 500-600°C, suggesting long-range diffusional α' → γ transformation. With the aid of electron channeling contrast image technique (ECCI), we noticed that the formation of γ–nanograins in the early stages of reversion is sufficient to induce strong magnetic shape anisotropy in this steel. After full austenitization at 800°C, further *in* situ magnetic measurements were also used to track the magnetic response of the material upon controlled cooling. Athermal formation of α'-martensite within the prior athermal ε-phase was clearly observed for temperatures lower than 100°C. Using thermodynamic modeling we also calculated the start temperature for ε-formation (M_s^{ε}). Results showed that ε-martensite is indeed expected to form before α', which was confirmed in all cases by means of EBSD.

Keywords: 17.6Mn-TRIP steel; strain-induced martensite; austenite reversion; athermal α'; athermal ε; magnetic properties.

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