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Investigation of structural and magnetic properties of rapidly-solidified iron-silicon alloys at ambient and elevated temperatures

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Abstract

We investigated the ambient temperature structural properties (thickness, width, microstructure, and lattice parameter), and the ambient and high temperature (up to 900 K) direct current (DC) magnetic properties—saturation magnetization (M_S) and intrinsic coercivity (H_{CI})—of rapidly-solidified (melt-spun) Fe-*x* wt.% Si (*x* = 3, 5, & 8) alloys. The wheel surface speeds selected for the study were 30 m/s and 40 m/s. The ribbons produced at the lower wheel surface speed (30 m/s) were continuous having relatively uniform edges compared to the ribbons produced at the higher wheel surface speed. The thickness and the width of the melt-spun ribbons ranged between ~15-60 μm and 500-800 μm, respectively. The x-ray diffraction spectra of the melt-spun ribbons indicated the presence of disordered *α*-phase, irrespective of the composition, and the wheel surface speed. The lattice parameter decreased gradually as a function of increasing silicon content from ~0.2862 nm (Fe-3 wt.% Si) to ~0.2847 nm (Fe-8 wt.% Si). The wheel surface speed showed an insignificant effect on M_S while increased silicon content resulted in a decreasing trend in M_S. Elevated temperature evaluation of the magnetization (*M*-*T* curves at ~7.96 kA/m) in the case of Fe-3 & 5 wt.% Si alloy ribbons was distinctly different from that of the Fe-8 wt.% Si alloy ribbons. The curves of