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Nano-crystallization of amorphous alloys by ultra-rapid annealing: An effective approach to magnetic softening

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Abstract

Primary crystallization of Fe-based amorphous precursors often results in the formation of magnetically soft nanostructures. The vast majority of alloys developed for this processing route contain nonmagnetic additives such as Cu and Nb for large nucleation rates and small crystal growth rates. However, we have demonstrated that magnetically soft nanostructures can be obtained in a simple Fe-B binary system without these traditional additives by employing ultra-rapid annealing. This is of technological significance as the Fe content in the nanostructure is increased to that of Si steels and a high saturation magnetization up to 1.92 T is obtained along with a low coercivity < 8 A/m. The nanoscale grain refinement in the Fe-B binary alloys is attributable to the contribution of viscous flow to the homogeneous nucleation kinetics. The formation of magnetically soft nanostructures in a simple Fe-B binary system opens up the possibility for further alloy development in compositions which were previously abandoned.

Keywords: amorphous materials; nanostructures; liquid quenching; magnetic measurements

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