

Crystallization and structural relaxation of $\text{Fe}_{73-x}\text{Pt}_x\text{B}_{10}\text{Si}_{12}$ metallic glasses

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Metallic glasses of $\text{Fe}_{78-x}\text{Pt}_x\text{B}_{10}\text{Si}_{22}$ ($x = 0, 5, 15, 25$) were thermally annealed to study their crystallization behaviors and resulting magnetic properties depending on the Pt content. It was observed that the onset of the devitrification was progressively delayed with increasing Pt content. The Pt-free metallic alloy crystallized at 516 °C (at a heating rate of 10 °C/min) whereas crystallization temperature for the $\text{Fe}_{53}\text{Pt}_{25}\text{B}_{10}\text{Si}_{22}$ alloy was reduced to as low as 389 °C at the same heating rate. In all $\text{Fe}_{78-x}\text{Pt}_x\text{B}_{10}\text{Si}_{22}$ alloys, Fe_3Pt was found as part of the final crystallization product while $\alpha\text{-Fe}$ replaced $\alpha\text{-Fe}$ with increasing Pt content. In fact, the main crystalline phase for the annealed $\text{Fe}_{53}\text{Pt}_{25}\text{B}_{10}\text{Si}_{22}$ alloy was tetragonal FePt . As expected, both saturation magnetization and the Curie temperature of the metallic glasses dropped by the alloying of paramagnetic Pt. However, in spite of the large fraction of FePt with high magnetocrystalline anisotropy found in the crystallized $\text{Fe}_{53}\text{Pt}_{25}\text{B}_{10}\text{Si}_{22}$ alloy, the highest coercivity was obtained when $x = 15$, reaching 1140 Oe after annealing at 500 °C. Furthermore, when Pt was added to the Fe-rich metallic glasses, all alloys exhibited increase in the saturation magnetization after annealing below the crystallization temperature. The increase in the magnetic moment was tentatively attributed to the structural relaxation of the amorphous structure. To confirm the relaxation effect, the quenching wheel speed was deliberately lowered which resulted in the increase of the saturation magnetization of the as-cast alloy as well as the onset temperature of the devitrification. The addition of Pt to the Fe-rich metallic glasses appears to destabilize the glass structure, which led to the structural relaxation prior to devitrification and reduction of the crystallization temperature.

References

- [1] J. L. Walter, *Mat. Sci. & Eng.* **50** (1981) 137.
- [2] M. Hrabcak, A. Lovas, J. Kovac, L. Novak, *IEEE Trans. Magn.* **30**(2), 516 (1994)