Crystallization and Magnetic Properties of Co-Pt Amorphous Metallic Alloys with Pt contents

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Co-based amorphous metallic alloys, $Co_{78-x}Pt_x(BSi)_{22}$ (x = 5, 15, 25, 39), were produced by using the melt-spinning process in order to study the crystallization behavior and ensuing magnetic properties of the Co-Pt amorphous alloys as a function of the Pt content. During annealing, below x = 15, the main crystallization product was Co with Pt dissolved in its lattice. The Co-Pt metallic glasses were fully crystallized between 500℃ and 600℃ with increasing amount of the Pt addition proportionally lowering the devitrification temperature. In compositions below x = 15, the Pt addition favored the nucleation of the hcp phase which converted to the fcc phase as the annealing temperature was increased. Pt atoms in the crystallized alloy suppressed the precipitation of secondary phases such as cobalt borides, as the expanded crystalline lattice due to the Pt addition enabled better accommodation of the metalloid elements [1]. With $x \geq 25$, the Pt content in the composition was high enough to nucleate the CoPt crystals well below the stoichiometric composition of CoPt. In spite of the nucleation of CoPt with its high magnetic anisotropy, the highest coercivity was obtained when x was 15. We believe that the comparatively high coercivities of the $Co_{73}Pt_5(BSi)_{22}$ and $Co_{63}Pt_{15}(BSi)_{22}$ alloys were due to the high density of stacking faults within the Co grains combined with the uniaxial anisotropy of hcp Co [2]. It is speculated that as CoPt became the dominant crystallization product, density of stacking faults proportionally decreased; thus, reducing sites where domain walls can be pinned. Reversibility of crystallized alloys is indicative of the relative fraction of CoPt and Co because of the difference of their respective coercivities[3]. Increasing the fraction of CoPt with a comparatively high coercivity will increase the reversibility. As the amount of CoPt crystals increased with annealing temperature, as expected, reversibility increased. In addition, reversibility for the alloy with x = 25 was higher than that of x = 39 since the fraction of CoPt decreased due to the Pt_2B_3 formation when x = 39.

References

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