SYNTHESIS OF CoPt NANOPARTICLES IN Al_2O_3 AND SiO_2

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Ion implantation and thermal processing have been used to synthesize CoPt nanoparticles in crystalline Al_2O_3 and amorphous SiO_2 matrices. In Al_2O_3, the nanoparticles are produced using high-temperature (500°C) implantation of overlapping profiles of Co (360 keV) and Pt (910) ions. Subsequent thermal annealing in a reducing environment leads to precipitation and nanoparticle formation. The atomic fraction of Pt in the alloy [Pt/(Co + Pt)] can be changed over a wide range by controlling the relative doses of implanted Co and Pt. For compositions near 50% Pt, annealing at 1100°C/2 h results in the creation of CoPt nanoparticles with the tetragonal $L1_0$ structure. These nanoparticles exhibit multiple orientations within the crystalline Al_2O_3 matrix, but they have a low order parameter and a very low magnetic coercivity. Additional annealing for 120 h at 700°C (below the order/disorder transition temperature of CoPt) greatly improves the coercivity to ~1 Tesla (at 5K). For samples with Pt atomic fractions near 75%, x-ray measurements suggest the cubic $L1_2$ $CoPt_3$ phase is formed. Implantation and annealing is also being used to form ferromagnetic CoPt nanoparticles in SiO_2. For alloy compositions near 50% Pt, the nanoparticles have a coercivity in excess of 0.5 Tesla following room temperature implantation and extended annealing at 750°C.

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