FORMATION OF FERROMAGNETIC FePt NANOPARTICLES BY ION IMPLANTATION

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We have used sequential ion implantation of Fe and Pt, followed by thermal annealing to form ferromagnetic FePt nanoparticles with extremely high magnetic coercivity (greater than 2 Tesla) embedded in both crystalline Al_2O_3 and amorphous SiO_2 matrices. In Al_2O_3, the nanoparticles are crystallographically oriented and particle size varies from a few nm to ~100 nm depending on the implantation and annealing conditions. Nanocomposites with both single and multiple orientations of nanoparticles have been produced. By changing the relative doses of Fe and Pt, we have varied the Pt atomic fraction [Pt/(Fe + Pt)] from 25% to 73%. In the Pt-atomic-fraction range from 35% to 53%, x-ray diffraction measurements show that the chemically ordered $L1_o$ tetragonal phase of FePt is produced. These nanoparticles are ferromagnetic with a coercivity that maximizes at a Pt concentration of ~45%. In this case, the coercivity can exceed 2 Tesla (at 30K). At lower (25%) and higher (73%) Pt concentrations, the x-ray diffraction results are close to those expected from the $L1_2$ structures of Fe_3Pt and $FePt_3$, respectively.

In SiO_2, the FePt nanoparticles are randomly oriented, and the particle size varies from a few nm to ~70 nm depending on the implant and annealing conditions. For FePt nanoparticles in SiO_2, the coercivity can exceed 2 Tesla (for a Pt atomic fraction of 45%). The application of these techniques to form FePt nanoparticles in other matrices is under investigation.

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