FePt ORDERED ALLOY NANOPARTICLES PRODUCED BY ION BEAM SYNTHESIS

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We have used sequential ion implantation of Fe and Pt followed by thermal annealing (1100°C/2 h) to produce ordered $Fe_{1-x}Pt_x$ alloy nanoparticles in single crystal Al_2O_3. The nanoparticles are crystallographically oriented with respect to the Al_2O_3 matrix and the microstructure, orientation, and particle size depend strongly on the implantation conditions. By changing the relative doses of Fe and Pt, we have produced alloys where the Pt atomic fraction [Pt/(Pt + Fe)] varies from ~25% to ~75%. Ordered alloys with the $L1_0$ or the $L1_2$ structure have been synthesized depending on the Pt concentration. In the range of 35% to 53% atomic percent Pt, the chemically ordered $L1_0$ phase of FePt is formed with an order parameter that approaches unity. These nanoparticles are ferromagnetic and have a very high coercive field that maximizes at a Pt atomic fraction of ~45%. Magnetic coercivities as high as 33 kOe (at 5K) have been measured for $Fe_{55}Pt_{45}$ alloys. At lower Pt atomic fractions (~25%), the chemically ordered $L1_2$ phase of Fe_3Pt is formed. The order parameter is <0.5 if the sample is annealed at 1100°C, but substantial improvement occurs (to ~0.8) with prolonged annealing below the order-disorder transition temperature. At high atomic fractions (~75%) the ordered $L1_2$ phase of $FePt_3$ is formed with an order parameter of ~0.8. Results will be presented demonstrating that the phase formed and the magnetic properties depend strongly on the annealing environment.

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