Low Temperature Magnetic Studies of FePt Nanoparticles Using SQUID

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FePt nanoparticles were prepared at University of Alabama by the simultaneous polyol reduction of platinum acetylacetonate and iron acetylacetonate, giving about 4 nm average diameter FePt particles. We have used the ion-beam irradiation to reduce the ordering temperature of FePt nanoparticles. FePt particles dispersed on a Si-substrate were irradiated by 300 keV Al-ions with a dose of 1 x 10^{16} ions/cm^2 at Auburn University, AL. Irradiation induced vacancies enhanced chemical ordering during annealing at temperatures as low as 220 °C. As the annealing temperature increased, anomalous features in the magnetization reversal curves were observed those may be associated with lattice strain caused by vacancy clusters. To further examine the lattice strain related anomaly, we used GSU's SQUID magnetometer and obtained hysteresis loops from room temperature to 4.2 K of pure and irradiated FePt nanoparticles after annealing to maximize the vacancy aggregation. Two magnetic phases (normal phase with high H_c and defect stress related phase with low H_c) are clearly seen in hysteresis loops at 4.2 K, only in the case of irradiated samples. The lattice strain around the vacancy clusters increases as we cool the sample, and the strain related phase is prominent as indicated by a decrease in the effective coercivity at low temperatures for irradiated sample compared to the pure FePt particles.