Magnetic and structural properties of FePt $L1_0$ thin films

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FePt thin films in the $L1_0$ phase are interesting candidates for high-density magnetic recording media due to their large perpendicular magnetocrystalline anisotropy[1]. In the present work two series of epitaxial $Fe_{1-x}Pt_x$(30 nm) films were grown through MBE on MgO(100) substrates. In the first series, the film composition was kept constant while the substrate temperature was varied between 400°C and 650°C. In the second series the substrate temperature was kept constant at 500°C while the stoichiometry was varied in the range of $43-71$ at.% Pt. The purpose was to study the perpendicular magnetocrystalline anisotropy and its relation to the structural properties of the thin films.

The FePt thin films were characterized with vibrating sample magnetometry, x-ray diffraction, Rutherford backscattering and CEMS. From the out-of-plane magnetization loops the coercivity is extracted for the different samples. The coercivity first increases with increasing substrate temperature, peaking at $500-550$°C, and then rapidly drops, as illustrated in figure 1.(a). A similar dependence is observed for the normalized out-of-plane-lattice parameter. These results are in agreement with what has been reported by Farrow et al[2]. Figure 1.(b) shows the concentration dependence of the coercivity for the second series. The optimal coercivity corresponds to a 5 to 10% excess of Pt. These results show that the magnetic hardness of the FePt $L1_0$ films can be manipulated through the preparation conditions, i.e. the substrate temperature during deposition and the composition of the FePt film. We have also found a correlation between the magnetic hardness and the structural ordering.

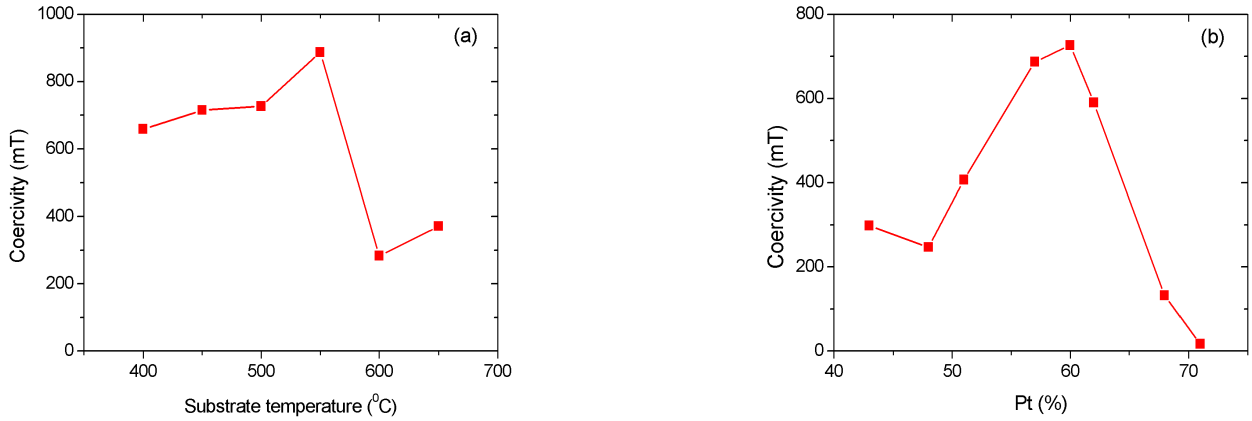

FIG. 1: The substrate temperature and concentration dependence of the coercivity of $Fe_{1-x}Pt_x$(30 nm) $L1_0$ thin films.

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