Determination of structural properties of magnetic FePt- and CoPt-films

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Today, magnetic data storage is the most common method to store information. Driven by the growing ammount of data, the storage capacity of such devices needs to be increased. This aim can be reached by decreasing the area covered by the smallest information unit (bit). In current granular media, consisting of exchange isolated magnetic CoCrPt grains, the diminution of this area can only be achieved by reducing the grain size of the of the storage layer. However, the approach of scaling down the size of the magnetic grains has reached the so-called superparamagnetic limit, where the requirement of thermal stability is no longer fulfilled. Materials with a higher uniaxial perpendicular magnetic anisotropy than CoCrPt are required to realize smaller grain sizes. FePt or CoPt in their (001)-textured $L1_0$-phase are promising candidates to achieve these smaller grains while maintaining the required thermal stability [1].

5 nm thick chemically disordered films composed of $Fe_{0.52}Pt_{0.48}$ and $Co_{50}Pt_{50}$ have been prepared by sputter deposition on Si-wafers covered with 100 nm thermally grown amorphous SiO_2 top layer. These disordered and polycrystalline films can be transformed into the $L1_0$ ordered and (001)-textured magnetic films during a rapid thermal annealing (RTA) process [2]. However, the underlying mechanism to trigger the evolution of the (001) texture is not well understood. In this study $Fe_{0.52}Pt_{0.48}$-films have been annealed for 30 s at temperatures of 450°C to 850°C in steps of 50 K. A maximum temperature of 900°C has been chosen for the $Co_{50}Pt_{50}$ samples.

The X-ray diffraction experiments have been carried out at HASYLAB beam-line G3. The energy of the incident radiation was chosen to be 8048 eV which is equivalent to the Cu-K_α-radiation used at our own laboratory equipment. Using a LaB_6 powder sample the calibration of goniometer and radiation energy was verified. The samples have been investigated using θ-2θ-geometry. The texture of the samples was determined using pole-figure measurements.

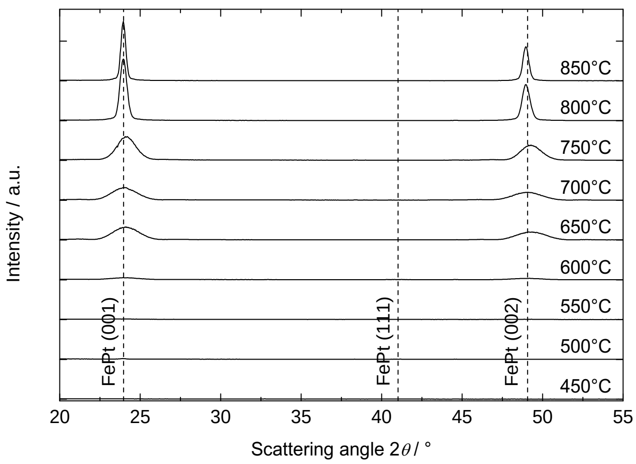

Figure 1: X-ray diffraction patterns measured at 5 nm thick $Fe_{0.52}Pt_{0.48}$-films annealed for 30 s at the temperatures displayed in the figure.

Figure 1 shows the diffraction patterns measured at 5 nm thick $Fe_{0.52}Pt_{0.48}$-films annealed for 30 s at various temperatures. The transformation from the disordered phase into the $L1_0$-phase starts at annealing temperatures of 600°C. The intensity of the (001) and (002) peaks connected to the $L1_0$-phase increases with the temperature. The FWHM of the peaks decreases with increasing temperature which points out the growth of crystallites and possibly the reduction of microscopic stress within the crystallites.

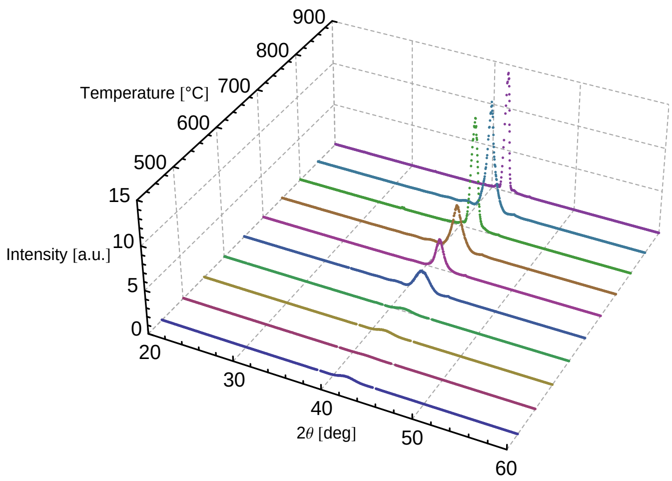

Figure 2: XRD patterns of 5 nm thick $Co_{50}Pt_{50}$ alloy films as a function of the annealing temperature for the RTA process

The diffraction patterns of the $Co_{50}Pt_{50}$ samples as a function of annealing temperature shown in figure 2 exhibit only the (111) peak for Co-Pt alloy at 41.6°. Due to the missing superstructure peaks no long range order can be observed for any temperature. Therefore the (111) peak might be caused by the disordered A1 phase of the Co-Pt alloy. In addition the increasing intensity of the peak with increasing temperature is due to the change of the film morphology.

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