Structural and magnetic properties of the A1 to $L1_0$ transformation in polycrystalline $Fe_{56}Pd_{44}$ alloy thin films produced by thermal evaporation technique

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X-ray diffraction and SQUID magnetometer techniques have been used to characterize the evolution of the structural and magnetic properties of phase transformation from disordered FePd face-centered cubic (A1) phase,toan ordered phase $L1_0$FePdof tetragonal structure. This study was carried out using a vacuum isothermal annealing at 550°C as afunction of time for the $Fe_{56}Pd_{44}$thin film alloy deposited on Si substrate. The X-ray diffraction allows us to follow the evolution of the lattice parameters (*a* and*c*) of the ordered phase. Magnetic measurements (SQUID) allow us to follow the coercive field (H_C) and the saturation magnetization (M_S) at different stages of the transformation.

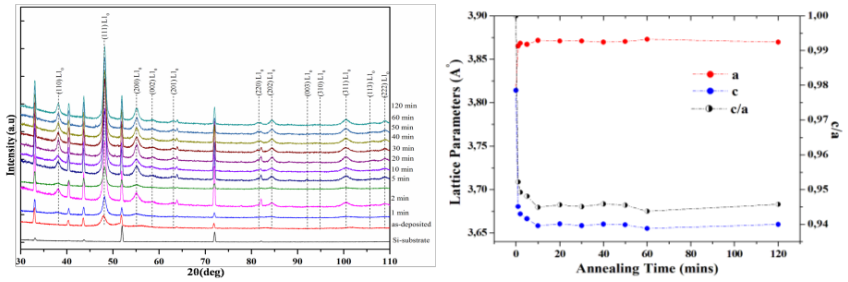

Figure 1. Left to right: X-ray diffractogramsfor various annealing timesfor the $Fe_{56}Pd_{44}$thin filmalloys. The lattice parameters of the $L1_0$FePd phase as a function of the annealing time.

The presence of super-lattices (110) and (201)peaks, and the splitting of the (200), (220) and (311)peaks (left panel of Figure 1)are signatures of the phase transformation from the disordered FePd phase into the ordered $L1_0$FePd phase. On the other hand, the ratio (c/a) is around 0.945 reflecting the formation of the tetragonal structure(right panel of Figure 1).

We note that during the first 10 minutes of annealing, the evolution of M_S and $H_C$corresponds to a phase transformation from a disordered FePd phase toan ordered $L1_0$FePd phase

(Figure 2).After the first 10 minutes, we demonstrate that the M_S and $H_C$evolution are governed by the presence of structural defects in this alloy.

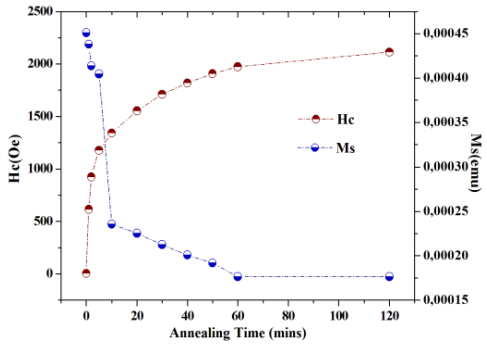

Figure 2. Saturation magnetization (M_S)and coercive field (H_C) of the $L1_0$FePd as a function of annealing time.