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Mechanism of magnetisation reversal in thin L1$_0$ FePd nanopatterned layers

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Thin magnetic films of FePd, FePt and CoPt alloys are technologically important because of their large anisotropy (˜10^7 erg/cm^3) and strong coercivity (˜1000 Oe). Many studies are performed in order to obtain thin magnetic films of ordered L1$_0$ FePd alloy with tuned magnetic parameters. The shape of hysteresis loops and coercivity values of magnetic systems are directly dependent on mechanisms of the magnetization reversal. Defects in continuous film created by magnetic layer deposition on ordered porous templates cause changes in magnetization reversal mechanisms. In this study we examined the influence of template morphology on coercivity, remanence and magnetization reversal mechanism of thin FePd alloy film with L1$_0$ structure. The alloys were obtained from $\mathrm{Pd_{2nm}/[Fe_{4nm}Pd_{6nm}]x4/Fe_{4nm}/Pd_{4nm}}$ multilayers after vacuum annealing at 600°C. In our study we investigated films deposited on Al_2O_3 nanoporous templates of two kinds: with flat (template F) or with hemispherically curved (template C) interpore areas. The films on flat Si/SiO$_2$ wafer were used as reference samples.
The angular dependencies of $\mathrm{M}_R/\mathrm{M}_S(\varphi)$ reveal isotropic properties of films deposited on template C, and in-plane magnetic anisotropy for flat films on Si/SiO$_2$ wafer and on template F. The mechanisms of reversal magnetization inherent for the systems were investigated by determination of the angular dependence of coercivity $\mathrm{H}_C(\varphi)$ and compared with theoretical models of Kondorsky, modified Kondorsky and Stoner-Wolfarth (Figure 2 b). Isotropic properties of curved films were also proved by $\mathrm{H}_C(\varphi)$. Film on template F and on flat Si/SiO$_2$ wafer exhibit different magnetization reversal mechanisms. The differences in the magnetization reversal mechanisms can be explained by the loss of continuity of the film and formation of islands during partial dewetting after annealing. In the same conditions porous film maintains its uniformity as observed by SEM imaging.

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