Tailoring the perpendicular magnetic anisotropy and magnetic domains size in Co/Pd multilayers with the addition of an ultrathin W layer at the interfaces

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Materials presenting perpendicular magnetic anisotropy (PMA) have attracted a growing interest over the last years. Their high out-of-plane anisotropy leads to small magnetic domains which could enable the development of more compact magnetic memory and logic devices. In this sense, it is needed to understand the magnetization processes and to control the domains formation in PMA nanostructures. In this work, we studied the PMA and the domains pattern formation in Co/Pd magnetic multilayers in terms of the addition of an ultrathin W (tungsten) layer at the interfaces. We fabricated [Pd (2 nm)/Co (0.6 nm)/W (t)/Pd (2 nm)]x15 (t = 0, 0.1, 0.2, 0.3 and 1 nm) samples by magnetron sputtering, then carried out magnetization loops with magnetic field applied both out-of-plane and in-plane to check their anisotropy, and imaged their domains pattern by magnetic force microscopy (MFM) in both as-grown and remnant states. We observe that the out-of-plane remanence drops with the addition of 0.1 nm of W at the top interfaces, but turns out to increase again with the addition of thicker W layers, overcoming the remanence of the reference sample (no W) for the thickest W layers (1 nm). The minimum of the curve “remanence vs W thickness” coincides with the smallest magnetic domains size visualized in the MFM images, the domains size scaling very well with the out-of-plane remanence. This behavior has likely to do with the multilayer structure which should present rougher interfaces for ultrathin W layers with thicknesses close to the percolation limit of a W layer onto Co, and flatter interfaces when a continuous W layer is formed. This structural effect is being investigated through x-ray reflectometry analysis whilst its effects on the magnetic anisotropy energies resulting in the observed properties is being elucidated through micromagnetic simulations.