Supporting Information

Quantitative observation of magnetic flux distribution in new magnetic films for future high density recording media.

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The sample was grown on MgO (001) substrate by Molecular Beam Epitaxy (MBE) according to the following sequence : Cr (2.5 nm) in order to initiate the epitaxial growth, Pd (48 nm), FePd (15 nm) co-deposited at room temperature, FePd (37 nm) co-deposited at 450 $^{\circ}C$ and a 1.5 nm caping of Pt was added to avoid oxydation. The sample has been prepared for electron microscopy using mechanical polishing and ion milling. The layer is thus exhibiting a double wedge geometry along the observation plane. The microscope used for the holography experiments is a FEI Tecnai F20 field-emission-gun TEM fitted with a Cs corrector (CEOS). A FEI Titan FEG TEMfitted with a dedicated Lorentz lens was used for Fresnel imaging. A Gatan Imaging Filter was also used for zero loss filtering for the Fresnel images. Holograms are recorded using off-axis electron holography with a rotatable biprism located in the SA aperture. The biprism is aligned along the foil direction x. The fringe spacing is 1.8 nm, the fringe contrast is 12 %. For calculating the phase image we perform a Fourier transform of the hologram and apply a mask of 0.25 nm^{-1} on the side-band spot before calculating an inverse Fourier transform. To separate the electrostatic and magnetic contributions to the phase shfit, two holograms were recorded before and after inverting the sample. Image calculations were then performed to aligned the two images. The phase images have been digitally flipped for accordance with the physical inversion of the sample. After data acquisition, an accurate correction of the drift, rotation and scaling between the two images has been performed using recently developped scripts. Mean Inner Potentials have been calculated using the Doyle and Turner scattering amplitude corrected with the Ross and Stobbs equation (see chapter 12 of.[22]) We calculate : $V_{FePd_{L1_0}} = 21.73$ V, $V_{FePd_{dis.}} = 22.67$ V, $V_{Pd} = 22.37$ V. Micro-magnetical simulation has been carried out using the bulk FePd following parameters: Exchange constant $A = 6.9 10^{-12}$ $J.m^{-1}$, Uniaxial Anisotropy $K=1.03\ 10^6$ $J.m^{-3}$, Saturated Magnetization $\mu_0 M_s = 1.294$ Tesla . The cells are $0.781nm \times 0.625nm$ and infinite along the z direction (considered as invariant).