Magnetization reversal and domain structure in Ta/CoFeB/MgO films and its dependence on CoFeB Thickness

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Magnetization processes and magnetic domain structures were studied for Ta/CoFeB (thickness d from 1.24 to 1.60nm)/MgO stacks deposited by dc/rf magnetron sputtering on thermally-oxidized Si substrates. Polar magneto-optical Kerr effect (PMOKE) based magnetometry and microscopy were used. Thickness dependence of magnetic anisotropy was evaluated and described by both second and fourth orders of anisotropy constants. While increasing d, owing to the dependence, magnetization reorientation from out-of-plane to in-plane direction through an easy cone magnetization region (1.37 nm $<$ d $<$ 1.39 nm) was deduced. Magnetic field pulses driven magnetization reversal processes were analyzed using a developed software capable of digital processing of images from PMOKE microscope. Magnetization reversal processes for out-of-plane easy axis stacks indicated significant increase of the density of nucleation centers and change in domain morphology while increasing d up to the magnetization reorientation thickness. Magnetic after effect was found. The thinnest films with d = 1.24 and 1.28 nm show an appearance of straightened narrow stripe domains resulting from a magnetic dipolar repulsion [1]. The application of such structures as spin-wave nano-channels could be promising.

References:

[1] 1. Dhiman et. al., Magnetization processes and magnetic domain structures in Ta/CoFeB/MgO stacks, 529, 2021, doi:https://doi.org/10.1016/j.jmmm.2020.167699.

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