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CATEGORY: Characterization & imaging

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TITLE: Field driven ferromagnetic phase evolution originating from the domain boundaries in antiferromagnetically coupled perpendicular anisotropy films

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Digest Body: Strong perpendicular anisotropy systems consisting of Co/Pt multilayer stacks that are antiferromagnetically coupled via thin Ru or NiO layers have been used as model systems to study the competition between local interlayer exchange and long-range dipolar interactions [1,2]. Magnetic Force Microscopy (MFM) studies of such systems reveal complex magnetic configurations with a mix of antiferromagnetic (AF) and ferromagnetic (FM) phases. However, MFM allows detecting surface stray fields only and can interact strongly with the magnetic structure of the sample, thus altering the original domain configuration of interest [3,4].
In the current study we combine magnetometry and state-of-the-art soft X-ray transmission microscopy (MXTM) to investigate the external field driven FM phase evolution originating from the domain boundaries in such antiferromagnetically coupled perpendicular anisotropy films. MXTM allows directly imaging the perpendicular component of the magnetization in an external field at sub 100 nm spatial resolution without disturbing the magnetic state of the sample [5,6]. Here we compare the domain evolution for two similar [Co(4Å)/ Pt(7Å)]x-1/ {Co(4Å)/Ru(9 Å)/[Co(4Å)/ Pt(7Å)]x-1}16 samples with slightly different Co/Pt stack thickness, i.e. slightly different strength of internal dipolar fields. After demagnetization we obtain AF domains with either sharp AF domain walls for the thinner multilayer stacks or "tiger-tail" domain walls (one dimensional FM phase) for the thicker stacks. When increasing the external field strength the sharp domain walls in the thinner stack sample transform into the one-dimensional FM phase, which then serves as nucleation site for further FM stripe domains that spread out into all directions to drive the system towards saturation (Fig. 1). Energy calculations reveal the subtle difference between the two samples and help to understand the observed transition, when applying an external field.

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(No Table Selected)

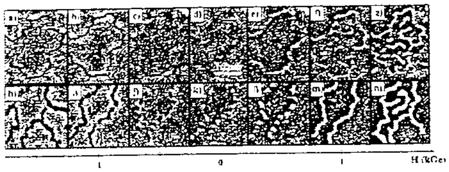

Fig. 1. MXTM images of [Co(4Å)/ Pt(7Å)]x-1/ {Co(4Å)/Ru(9 Å)/[Co(4Å)/ Pt(7Å)]x-1}16 magnetic domain configuration in the X = 6 (a-g) and X = 7 (h-n) cases, under -1.5 kOe (a,h), -1 kOe (b,i), -0.5 kOe (c,j), 0 Oe (d,k), 0.5 kOe (e,l), 1 kOe (f,m) and 1.5 kOe (g,n).