Crystal structure dependent magnetic properties of self-organized Co nanostrips probed by FORC technique

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Here we show the results of our study of the magnetic properties of Co nanostrips (NSs) with a width of 37 ± 3 nm, a thickness of 10 nm and a length of more than 5 µm fabricated on specially prepared Si(111) substrates with buffer layers of Cu, Cu_2Si and W-O. The presented technique can be used to produce homogeneous nanostrips from various materials, for example, ferromagnet/heavy metal NSs, which can be used as skyrmion racetracks and media for an efficient domain wall propagation.

Our investigation of the crystal structure has showed that epitaxial single-crystal nanostrips are grown upon deposition on the Cu buffer, epitaxial nanostrips with a block structure having an angle of misorientation of the blocks of 8 degrees are formed on the Cu_2Si buffer, and polycrystalline nanostrips are produced on the W-O sublayer.

Magnetic properties of the samples with various crystal structure were studied by a vibrating sample magnetometer using major hysteresis loop measurements and first order reversal curve (FORC) technique [1]. Figure 1 represents the FORC diagrams for three types of nanostrips. Insets show families of FORCs used to plot the diagrams. The single-crystal nanostrips demonstrate hard magnetic behavior with the coercive force near 1kOe. FORC diagrams for the single-crystal and block structure NSs have the same shape and H_c distributions, indicating on their length and width distributions. However, the block structure NSs have much smaller interaction field ΔH_u. As seen from Fig.1, peaks of H_c are shifted for the single-crystal NSs into the negative fields, while for the block structure NSs – into the positive fields. It can be explained by the deviation of the *c*-axis of *hcp*-Co from the parallel to the main strip axis orientation. Due to the disordered crystal structure the polycrystalline NSs have the complicated shape of the FORC diagram with the wide distribution of H_c, but there is no any shift of the H_c peak. This fact proves the crystal structure dependent behavior of the FORC diagrams.

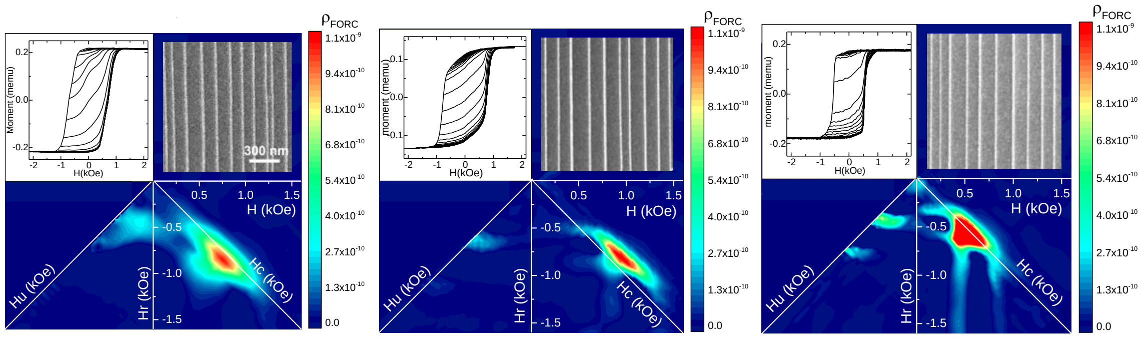

Fig. 1 FORC diagrams in the Preisach-type representation for (a) single-crystal, (b) block structure and (c) polycrystalline NSs. Insets contain FORCs used for the corresponding diagrams and SEM images of the NSs.

1. Mayergoyz, I.D., *Hysteresis Models from the Mathematical and Control-Theory Points of View.* Journal of Applied Physics, 1985. **57**(8): p. 3803-3805.