Dendrite domains structures in ultrathin cobalt films

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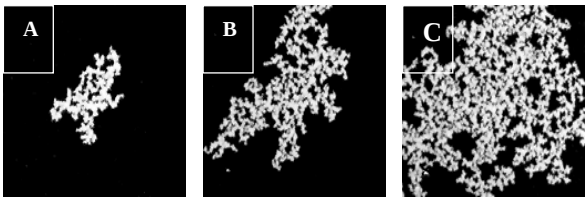
We report on a new type of a dendrite domain structure (DDS) in MBE grown cobalt ultrathin films of the following structure: Al_2O_3\Mo(20 nm)\Au(20 nm)\Co(*d* nm thick layer)\Au(8 nm). Cobalt films were chosen with *d* slightly below the reorientation phase transition thickness [1]. Samples are characterized by rectangle-like hysteresis loops observed by magnetooptical polar Kerr effect magnetometer. The domain structure study was performed by an optical polarizing microscope with CCD camera. Special software in LabView was developed for domain images processing. Images of remnant DDS were registered during magnetization reversal induced by perpendicular to sample plane magnetic field pulses with (i) increased pulses number or (ii) increasing the pulse amplitude. Figures show dendrite growth. Initially reversal domain nuclei appear in the selected film areas and further they grow by the domain wall propagation in various directions developing a dendrite structure as shown in the figures below. The total dendrite area increases with the number of field pulses (or time of applying field) significantly growing while the dendrite branch width does not practically change. We found that the dendrite branch width is about 5-7 μm. Such dendrite domains geometry differs from domain structure usually observed in ultrathin films [2]. The final stage of the dendrite evolution is a barely saturated magnetization state in which "hard" non-reversed magnetic domains still exist up to higher magnetic field. Such unexpected phenomenon of a nonsaturated state is related with the contributions of (i) the spatial distribution of the local coercivity field and (ii) domain magnetostatic forces keeping these isolated domains as ones of the size of about 1 μm.



The evolution of the domain structure for Co-films of thickness 1.5 nm. Images after: (A) H = +85.5 Oe; Δt = 1 s, (B) H = +85.5 Oe; Δt = 2 s, (C) H = +85.5 Oe; Δt = 3 s. The image size 0.11x0.10 mm.

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