Misorientations in magnetite thin films studied by electron backscatter diffraction

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Magnetite thin films grown on [0 0 1] oriented MgO substrates are analyzed by means of electron backscatter diffraction (EBSD) analysis. The EBSD technique enables the crystallographic orientation of individual grains to be determined with a high spatial resolution up to 40 nm. A high image quality of the recorded Kikuchi patterns was achieved enabling multi-phase scans (magnetite, MgO, maghemite). Upon annealing in air, the magnetic properties of the magnetite thin films were found to change considerably. Using EBSD analysis, we find that after 3 minutes annealing, most of the misorientations around 30°-40° are vanished, and some areas with high misorientation angles more than 45° remain. These misoriented grains form small islands with a size of about 100 nm. The size and distribution of these islands correspond well to the observations of antiferromagnetic pinning centers in the magnetic domain structures carried out by magnetic force microscopy (MFM) on the same samples. EBSD can recognize maghemite particles embedded *within* the magnetite matrix. The detected maghemite particles (4 % of the total) are found to be very small (~50 – 100 nm in diameter), but also clusters of them are detected. It is important to note that their presence is also causing misorientations within the magnetite matrix. The quality of such multi-phase EBSD analysis is discussed in detail.

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