Antiferromagnetic centers in $Fe_{3-\delta}O_4$ magnetite films

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Structures of magnetite ($Fe_{3-\delta}O_4$) and many other ferrites contain characteristic defects called antiphase boundaries (APB) resulting from the symmetry mismatch between a substrate and the ferrite[1]. In magnetic films containing APB, there is evidence of strong antiferromagnetic coupling across the APB[2]. These antiferromagnetic defects essentially determine the magnetism[2] and magnetoresistance[3] of the films. However, direct demonstration of the magnetic frustration at the APB was not achieved. In this letter we report the first imaging of antiferromagnetic coupling across APB. We employed epitaxial films of Fe_3O_4 grown on MgO(100). By postprocessing, the magnetite films, acquire a stripe domain pattern. This is indicative of a low density of magnetically active APB. As imaging tool we used a magnetic force microscope (MFM) in a variable magnetic field. By observation of rare remagnetization events we demonstrate the presence of dipolar centers resulting from the APB. Magnetization reversal of isolated and interacting groups of dipolar centers is shown. The observed centers are stable up to the maximum value of the applied fields.

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