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Strain and electric-field control of magnetism in iron oxide nanoparticle - BaTiO3 composites

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Ferrimagnetic iron oxide nanoparticle monolayers on top of ferroelectric BaTiO3 (BTO) substrates were prepared and a magnetoelectric coupling effect was observed. Grazing incidence small angle X-ray scattering and scanning electron microscopy confirm a hexagonal close-packed supercrystalline order of the nanoparticle monolayers. We employed a magnetoelectric AC susceptibility setup as modification of a commercial superconducting quantum interference device magnetometer. The magnetoelectric coefficient shows two jumps at the BTO phase transition temperatures. Moreover, the magnetic depth profile of the nanoparticle monolayer was probed by polarized neutron reflectivity. The data recorded at various electric field values show that the electric field is able to alter the magnetism of the nanoparticle monolayer by a strain mediated magnetoelectric coupling effect. Moreover, we prepared BTO films by pulsed laser deposition (PLD) where iron oxide nanoparticles were embedded in the BTO films. We observe also for this system a magnetoelectric coupling between the BTO film and the NPs via strain and interface charge co-mediation. This is demonstrated by measurements of the magnetization as function of DC and AC electric fields.

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2. L.-M. Wang, O. Petracic, S. Mattauch, A. Koutsioumbas, X.-K. Wei, M. Heggen, V.Leffler, S. Ehlert, and Th. Brückel, Magnetoelectric coupling in iron oxide nanoparticle - barium titanate composites, J. Phys. D: Appl. Phys. 52, 065301 (2019)

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