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# Distribution of antiferromagnetic domains in mixed nickel-cobalt oxide ($Ni_xCo_{1-x}O$) thin films

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Antiferromagnetic (AFM) materials are promising for future spintronic applications owing their advantageous properties such as robustness against perturbations due to magnetic fields, absence of parastatic stray fields or ultrafast dynamics (up to THz ranges). In a wide variety of AFM materials, transition metal oxides (e.g. NiO or CoO) play an important role due to their unique properties. These properties are especially evident in systems of reduced dimensionality, as pointed out by a number of studies [1, 2]. However, in thin film growth, as necessary for devices, the quality is often disappointing, dictated by the defect density.

Here we demonstrate a route for preparing high quality ultrathin antiferromagnetic oxide films on a metallic substrate. Mixed nickel, iron and cobalt oxides have been grown on Ru(0001) by high temperature oxygen-assisted molecular beam epitaxy. The nucleation and growth process are observed in real time by means of Low Energy Electron Microscopy (LEEM), which enables to optimize of the growth parameters. A comprehensive characterization is performed combining LEEM and LEED for structural characterization and PEEM (PhotoEmission Electron Microscopy) with synchrotron radiation for chemical and magnetic analysis via X-ray Absorption Spectroscopy and X-ray Magnetic Linear Dichroism (XAS-PEEM and XMLD-PEEM, respectively).

Depending on the chosen stochiometry the growth leads to the formation of high quality 2D islands of different compositions. The high crystalline and morphological quality of prepared films result in optimized properties with respect to films grown by other methods, such as magnetic domains, larger by several orders of magnitude. By means of vectorial magnetometry, the spin axis orientation was determined with nanometer spatial resolution, and found to depend on the Ni:Co ratio.

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