Ultrathin antiferromagnetic mixed nickel-cobalt oxide films

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Antiferromagnetic materials could represent the future of spintronic applications thanks to the numerous interesting features they combine: they are robust against perturbation due to magnetic fields, produce no stray fields, display ultrafast dynamics and are capable of generating large magneto-transport effects. However, their preparation as a thin films and detection still is a challenge due to their much more complicated analysis. Among many relevant antiferromagnetic materials one of the most interesting is cobalt and nickel oxides with Neel temperature of 291 K and 525 K respectively. They crystalize in the cubic rocksalt-structure, in which alternating layer of (111) Co (Ni) planes with opposite magnetization directions are separated by oxygen planes. These films supported on metal or semiconducting substrates play a crucial role in proposed electronic devices ([**?**]).

Here we demonstrate a route for preparing high quality ultrathin ternary transition metal oxide films on a metal substrate. Mixed nickel-cobalt oxides (NCO) have been grown on Ru(0001) by oxygen-assisted molecular beam epitaxy at elevated temperatures (800 – 900 K). The nucleation and growth process are observed in real time by means of Low Energy Electron Microscopy (LEEM), which enables the optimization of the growth parameters. The comprehensive characterization is performed by combination of soft X-ray absorption spectroscopy with photoemission electron microscopy (X-PEEM) which provides a powerful tool for imaging the domain structure in magnetically ordered systems.

We have been able to obtain high quality 2D islands of different compositions. The high crystalline and morphological quality result in optimized properties with respect to films grown by other methods, such as magnetic domains which are larger by several orders of magnitude, while the Neel temperature can be tuned by varying the Ni/Co ratio.

References

[1] J. Zhu et al. *J. Appl. Phys.* 115, 193903 (2014)