Epitaxial Europium Oxide on Ni(100)

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Stoichiometric EuO is one of the rare ferromagnetic semiconductors. Slightly Eu-rich EuO contains oxygen vacancies which cause an additional semiconductor to metal transition (SMT) with resistivity changes up to 12 orders of magnitude simultaneously with the ferromagnetic transition. Below T_C, charge carriers in EuO are completely spin-polarized.

As a first step towards the study of these effects on the atomic scale, EuO was grown on Ni(100) using reactive molecular beam epitaxy with ýlm thicknesses ranging from below one atomic layer up to several layers. The growth process is characterised at the atomic scale by in-situ variable temperature scanning tunneling microscopy (STM) and low energy electron diffraction (LEED).

The growth conditions (substrate temperature, O- and Eu-flux) were systematically varied to explore the available parameter space. Using appropriate growth parameters EuO ýlms grow quasi-pseudomorphically with their [100] direction oriented along the [110] direction of Ni, where two Ni nearest neighbour distances ýt the EuO lattice constant. Consequently, thin EuO films are slightly compressed. As a precursor to this phase EuO clusters with magic sites were found. These clusters are able to diffuse over the surface as stable entities. With increasing film thickness, the EuO layer relaxes and assumes its equilibrium lattice parameter. Besides the majority EuO(100) phase a minority EuO(111) phase was observed. This structure contains a polar surface and is thus energetically unstable. Upon further growth this phase is stabilized via the formation of (100)-facetted pyramids.

A second system studied are layered manganites, specifically $La_{1-x}Sr_{1+x}MnO_4$. This class of material shows charge and orbital ordering comparable to the more standard, non-layered perowskites. Preliminary STM results of the structure of surfaces obtained by in-situ cleaving will be presented.