GISAXS Analysis of Iron on Magnesium Oxide

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Fe(001) grown along the [110] direction of a MgO substrate shows a lattice mismatch of only 4% [1]. Therefore this combination is assumed to be an ideal system for the growth of 1 ML of a metal on an oxide. Unfortunately hitherto nobody did manage to grow a continuous monolayer of Fe on MgO. Hence, so far hardly any measurements have been conducted for iron films thinner than 20 Å since common techniques like STM do need current conducting surfaces. Grazing incidence small angle x-ray spectroscopy (GISAXS) turned out to be an appropriate alternative for determining the form, dimensions and positions of islands which are formed on the surface of MgO(001).

5 ML of Fe (≅ 14 Å) were deposited on a cleaved and polished MgO(001) surface by MBE (Molecular Beam Epitaxy). Afterwards the sample has been annealed at temperatures between 100 °C and 550 °C and GISAXS spectra have been collected for two different azimuthal angles. Three different island shapes were simulated using the software IsGISAXS [2], which has been developed at the ESRF (European Synchrotron Radiation Facility). The best fit is achieved by hemispheres as are shown in Fig. 1 (a). Fig. 1 (b) indicates the island growth at different temperatures. Vollmer-Weber growth is initiated at a temperature between 100 °C and 150 °C. At 200 °C the growth of the mean island diameter is decelerated indicating the Schwöbel barrier [3] being overcome from this temperature on.

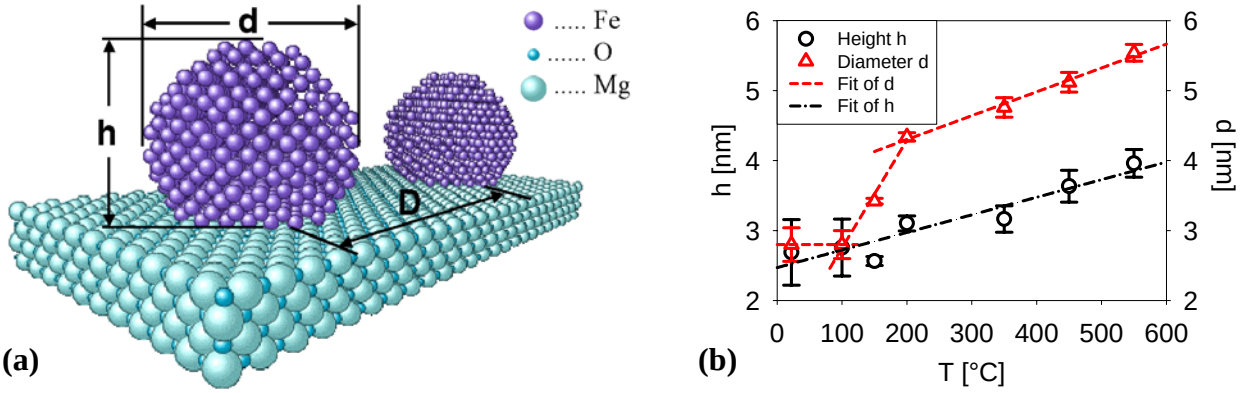

Fig. 1 (a) Shape of the simulated Fe islands for 5 ML Fe on a MgO (001) substrate. *d* is the mean diameter of the islands, *h* the mean height and *D* the mean distance between the islands. (b) shows the growth of the islands versus the temperature.

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