# Use of selected-area diffraction in LEEM

Farid El Gabaly, Juan M. Puerta, Angela Saa, Andreas K. Schmid, Jorge I. Cerda, Juan de la Figuera, Kevin F. McCarty

*Dpto. De Física de la Materia Condensada and Centro de Microanálisis de Materiales, Universidad Autónoma de Madrid, Madrid 28049 Spain*
*Instituto de Ciencia de Materiales de Madrid, CSIC, Madrid 28049, Spain*
*Lawrence Berkeley National Laboratory, Berkeley, California 94720, USA*
*Sandia National Laboratories, Livermore, California 94550, USA*

The Low Energy Electron Microscope (LEEM) is an instrument that has several advantages for Low Energy Electron Diffraction (LEED) data acquisition over traditional LEED spectrometers. Among them, the simplicity of: obtaining specular beam information, measuring the diffraction intensity as a function of energy (IV spectra), measuring very low energy spectra, or the ability to perform experiments with hot samples. More revolutionary is its capability to perform selected-area diffraction from areas on the sample that, depending on the instrument, can be a few microns in size. We show that IV spectra acquired with LEEM on selected areas may be analyzed in an analogous way as done in traditional LEED. Surface structural parameters can then be derived after full-dynamical LEED calculations via standard R-factor analysis. Given the local nature of the LEEM-IV technique, we are able to determine separately the structure of different terrace terminations and/or different domains that may coexist at the surface, as opposed to the traditional LEED where different domains are averaged out.

We present a LEEM-IV study applied to the layer-by-layer growth of cobalt films on Ru(0001). Although these films have attracted interest recently due to their magnetic properties [1], a detailed structural characterization is paramount for a proper understanding of those exciting properties. We will first present an analysis for the clean Ru(0001) surface, where the hcp nature of the substrate complicates laterally averaged LEED studies [2]. The resulting surface relaxation agrees excellently with first-principles calculations in the literature, unlike previous experimental measurements. We will then follow the layer-by-layer growth of Co films one, two and three monolayers thick. The structure of each film thickness is characterized by local-area LEED, making full use of the ability of LEEM for analyzing single-domain regions (e.g., of uniform thickness) *on the same terrace*. The structural information determined provides great insight into the thickness-dependent magnetic properties.

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[1] Farid el Gabaly et al., Phys. Rev. Lett. **96** 147202 (2006).
[2] J. de la Figuera et al., Surf. Sci, **600** L105 (2006).