Electrochemical Atomic Layer Deposition of semiconductor thin films

F. Carla'[1], A. Giaccherini[2], E. Berretti[2], M. Innocenti[2], F. di Benedetto[2], R. Felici[3]

[1]ESRF 71 Avenue des Martyrs 38000 Grenoble (France)
[2]Universita' di Firenze, Dip. di Chimica Via della Lastruccia 3, 50019 Firenze (Italy)
[3]CNR-SPIN, via del Politecnico 1, 00133 Roma (Italy)
carla@esrf.fr

The electrochemical atomic layer deposition (E-ALD) is an electrochemical method based on the alternated deposition of monoatomic layers of different elements forming a semiconductor compound. The E-ALD process takes place in water-based solutions and takes advantage of underpotential deposition phenomena to limit the electrodeposition process to a single monolayer. The method is extremelly energy and cost effective and allows to deposit highly ordered crystalline films with a well defined epitaxial relation with the metallic substrates used as working electrode. During the last years several structural studies [3-5] on the E-ALD process of different kind of semiconductors thin films (Cu_xS_y,CdS), which are particularly interesting as active materials for solar energy conversion, have been published. The structural characterization of the materials by Surface X-ray Diffraction (SXRD) carried out at the ID03 beamline of the European Synchrotron Radiation Facility highlighted the capability of the electrochemical deposition process in the growth of highly ordered films of materials with complex crystallographic structure (figure 1). In-situ/operando studies allowed to investigate the early stages of the deposition process and to clarify the structural evolution of the film during the growth. In this contribution we'll report on the results of an in-situ study conducted on the Cu_2S deposition process using a thin layer flow electrochemical setup. Thanks to the particular configuration of the setup and the high flux of the ID03 beamline it was possible to track the structural evolution of the film from the deposition of a single monolayer up to a nanometric thick film.

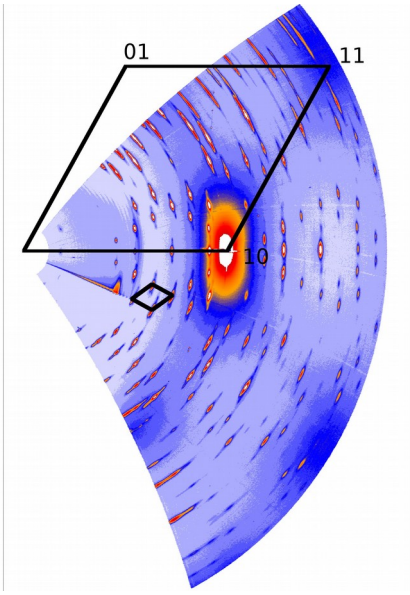

Figure 1. in-plane x-ray diffraction map (l=1.14) of a Cu_2S film (60 E-ALD cycles) on Ag(111) (the coordinates are referred to Ag(111) surface unit cell).

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