FORMATION OF ULTRATHIN CdS-FILMS ON CU(111) – AN IN-SITU STM STUDY

S. Hümann, P. Broekmann and K. Wandelt
Institut für Physikalische und Theoretische Chemie der Universität Bonn
Wegelerstr. 12, 53115 Bonn, Germany

Electrochemical Atomic Layer Epitaxy (ECALE) has been found to be a useful method to grow thin layers of semiconductor compounds at solid/liquid interfaces [1].
In this contribution we present STM data dealing with the epitaxial growth of ultrathin CdS-films on a Cu(111) electrode surface.
It will be shown that the atomic structure and the morphology of the resulting 2 layers thick CdS film strongly depend on the first layer adsorbed on the copper substrate.
A first preparation method of the CdS-films started with a sulfide covered copper surface.
Depending on the applied electrode potential two different sulfide layers can be observed by STM as reported by Wan et al. [2], on top of a Cu(111) surface exposed to a 10 mM S^{2-} electrolyte:

1. an incommensurate moiré pattern (Fig. 1)
2. a commensurate $\left(\sqrt{7}\mathrm{X}\sqrt{7}\right)R19.1°$-adlayer (Fig.2)

There is a broad potential regime in which both phases coexist. A deposition of the Cd within this sulfide coexistence regime does affect only the commensurate $\left(\sqrt{7}\mathrm{X}\sqrt{7}\right)R19.1°$ phase, while the incommensurate moiré pattern remains unaffected.
Cd deposition on the $\left(\sqrt{7}\mathrm{X}\sqrt{7}\right)R19.1°$ phase at a potential of –375 mV with respect to the RHE results in the formation of a CdS-phase revealing a complex dislocation network.
A totally different CdS phase can be observed starting with a Cd-UPD layer on top of the copper surface which is subsequently modified by a sulfide adsorption process.

References:
[1] T.E. Lister, J.L.Stickney, Applied Surface Science 107 (1996) 153-160
[2] Wang D. Xu Qm, Wan et al., Surf. Science, 499 L 159-163

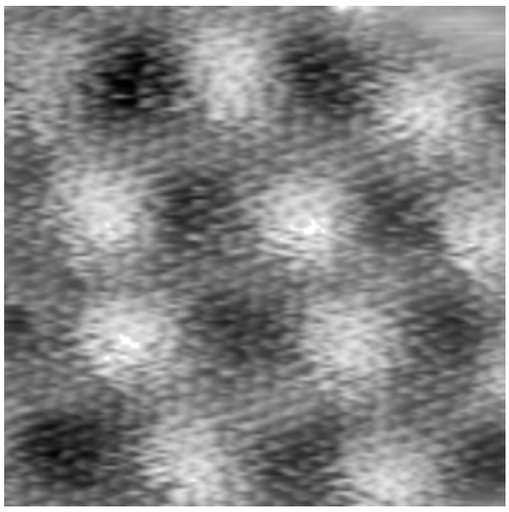

Fig. 1: Incommensurate S^{2-} induced moiré pattern on Cu(111)
12.78 nm x 12.78 nm

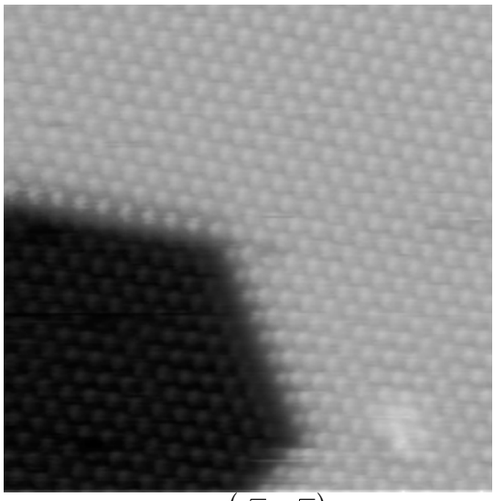

Fig. 2: Commensurate $\left(\sqrt{7}\mathrm{X}\sqrt{7}\right)R19.1°$ S^{2-}-adlayer on Cu(111)
15.1 nm x 15.1 nm

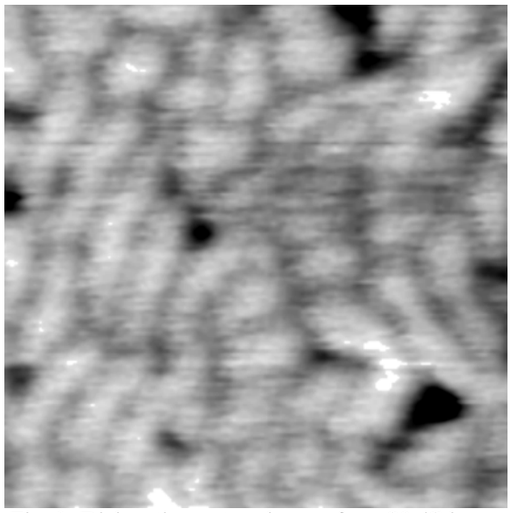

Fig. 3: Dislocation network seen for a S2-/Cd coadsoption layer on Cu(111)
27.1 nm x 27.1 nm