MS42-P15 | In situ X-ray studies of electrodeposition of lead-halide compounds on the electrolyte-liquid mercury interface

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We investigate nucleation and growth by in situ x-ray reflectivity and diffraction at liquid-liquid interfaces. Here we focus Hg as liquid metal substrate in an electrochemical environment. By changing the concentration, species and potential we can control the deposition mechanism. Liquid electrodes provide a stresses and defects-free template for nucleation and growth and ensure high mobility of reagent and products leading to high quality crystals.

In previous studies of electrolyte containing NaF+NaBr+$PbBr_2$ the growth of a monolayer followed by 3D nanocrystal formation of PbBrF was observed [1][2]. In the current experiments a fluorite free electrolyte with the halogens NaBr+$PbBr_2$ and NaCl+$PbCl_2$ is employed. By changing the potential from negative values < 0.8 V, where the Pb^{2+} ions are amalgamated in the Hg, to a potential > 0.7 V, the lead ions are deamalgamated and we see clear evidence of growth of a layer due to the formation of $PbBr_2$, $PbCl_2$ in the respectively experiments. The composition was confirmed by X-ray diffraction and grazing incident diffraction. The similar behaviour indicates that this growth behaviour is a general phenomena.

The layer growth may be explained by considering that for a potential greater than the amalgamation potential, the halide ions specifically adsorb onto the Hg surface. When the Pb^{2+} is released from the Hg bulk, they accumulate on top of the halide and form the detected layer.

[1] A. Elsen et al., PNAS., 110:6663 (2013)
[2]B. M. Murphy et al., Nanoscale, 29:13859 (2016)