X-RAY SCATTERING STUDY OF THE MERCURY-ELECTROLYTE-INTERFACE WITH THE EIGER 2D DETECTOR

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The layering of liquid metal surfaces can be described with a distorted crystal model (DCM) [2] having only three parameters. The layer periodicity, the layering decay length and a constant intrinsic roughness \(\sigma_i\) due to the atomic radius [4]. Additional to \(\sigma_i\) the surface of a liquid is further roughened by capillary waves with a roughness \(\sigma_{CW}\) [4] which cannot be separated experimentally from \(\sigma_i\). On our system the Hg-NaF(0.01 M) interface \(\sigma_{CW}\) should be fully described by capillary wave (CW) theory through the potential dependent surface tension \(\gamma\), the temperature \(T\) and the experimental resolution. But in contrary previous studies have shown that mercury does not simply follow CW theory [3, 5]. A classical roughness of the form \(\sigma^2 = \sigma_i^2 + \sigma_{CW}^2\) with a constant \(\sigma_i\) is unable to fully describe the roughness measured. Also a so called “beach” layer additional to the layers of the DCM has to be included to describe the low \(q_z\) range of the reflectivities [2, 3, 5]. This layer is much discussed and it is argued either to be an incomplete mercury or ion layer [6], a passivating oxide layer or surface impurities [3, 5]. Previously we used a Mythen 1d detector for these investigations, in this beam time for the first time we used an Eiger 2d detector [7]. We collected diffuse scattering (figure 1) and reflectivity measurements. Additional to their scientific value these measurement serve the as a good test for our new Eiger 2D detector which is the first commercially available next generation photon-counting hybrid pixel detector. After commissioning the Eiger detector we could compare the performance of the Eiger detector with the Mythen detector data on the same sample (figure 2 b)). With the Eiger detector the specular and the background signals are

![Figure 1: Diffuse scattering measurements with the Eiger detector over five orders of magnitude at \(q_z = 0.45\ \text{Å}^{-1}\), a potential of \(\phi = -0.35\ \text{V}\) and a temperature of \(4\,^\circ\text{C}\). The resolution in \(q_z\) direction reveals additional information about the lateral correlations on the liquid surface in a single shot. The small peak at low q values is the yoneda wing.](image-url)
collected in a single shot with a 12 bit dynamic range which is highly expanded due to the high frame rate of up to 3000 Hz. The resolution of the pixels is 75x75 µm. The measurements have been performed at the beam line P08, PETRA III at the LISA diffractometer [8] with a photon energy of 25 keV. We were able to collect data sets at $\phi = -0.85$ V with $T = 16^\circ$C, $23^\circ$C, and $T = 23^\circ$C with $\phi = -0.05$ V, $-0.55$ V, $-0.65$ V with the Mythen detector and the Eiger detector. With this preliminary data we can take a closer look to see if the "beach" layer produces diffuse scattering. Due to the subtle nature of the investigated phenomena the low noise, high dynamic range and high $q_z$ range of the Eiger detector are necessary to solve the open questions. In figure 2 the benefits for data quality is very apparent. This data will allow the detailed behavior of the diffuse scattering as a function of temperature and potential to be described. This work is ongoing. The project was funded by the BMBF project 05 K10FK2.

References