ESRF	**Experiment title:** FREEZING AT THE DIAMOND(111)/LIQUID-IN INTERFACE	**Experiment number:** SI 211
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Report:

We have attempted to perform X-ray scattering studies of the ordering phenomena that have been predicted to occur(1) in a liquid that is in contact with a crystalline solid. In particular, we are interested in the temperature dependence of these ordering phenomena. Near the interface, the liquid is expected to exhibit atomic layering in the direction along the surface normal, as well as ordering parallel to the interfacial plane. These theoretical predictions have not been counterparted by experimental verifications. For our model systems we have used clean (111) faces of silicon and diamond(2) crystals and as liquids we have chosen Ga and In.

The scattering geometry and set-up have been described in an earlier report of experiment SI 87[3]. In brief: the interface is illuminated from the substrate side with a monochromatic X-ray beam. After scattering from the interfacial region the photons travel through the crystal again on their way to the detector. This scattering geometry allows one to measure the diffraction intensities in the direction perpendicular to the surface that arise from the truncation of the crystal lattice at the interface. The interface was prepared in a dedicated ultra-high vacuum (UHV) set-up[4].

An accurately polished, low-miscut Si(111) sample was mounted in the scattering chamber that was pumped down and fixed onto a double tilt stage on the horizontal diffractometer of the TROIKA beamline. A clean (7 x 7) reconstructed Si(111) surface was prepared by flash-heating above 1100°C. Subsequently, a drop of liquid Ga of nominal purity 5N was decanted from the centre of the melt and was deposited onto the clean surface[5]. The 3rd harmonic of the small gap undulator was set to give a maximum flux at a photon energy of 25.8 keV (0.48 Å wavelength). This allows for measurements along the rods for vertical momentum transfers in the range $0 < Q_z < 5$ Å^{-1}.

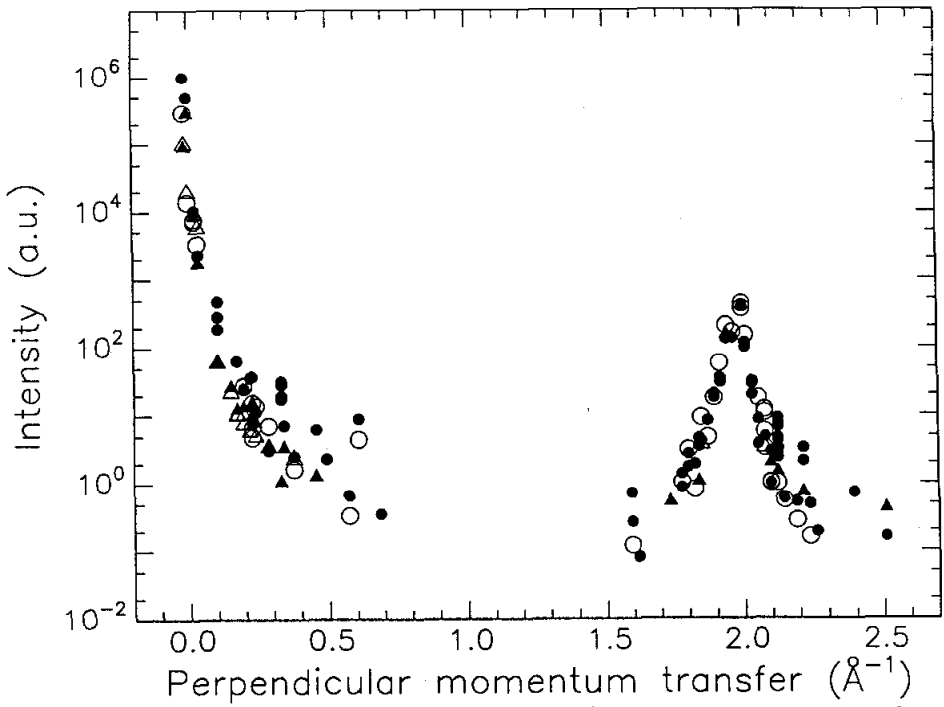

Figure 1. Specular reflectivity of clean and Ga-covered Si(111)-7×7. The internal reflectivity of the clean surface is represented by open symbols; that of the Ga covered surface by solid symbols.

Because of malfunctioning of the diamond monochromator of the TROIKA beamline, th.e actual experiment could not be performed. Some of the reflectivity data that were obtained during troubleshooting are shown in Fig. 1. The large scatter in the datapoints is caused by monochromator instabilities. Furthermore, an excessively high background level at the high photon energy needed for this experiment, severely limited the dynamic range of the measurements. We have also attempted to measure in-plane structure factors of the liquid near the interface. Unfortunately, also these measurements suffered from the aforementioned problems.

The raw specular reflected intensities in Fig. 1 were obtained by making scans in the scattering plane (circles) as well as perpendicular to the scattering plane (triangles). Intensities were measured up to a momentum transfer of 2.5 $Å^{-1}$. In the figure, the measured intensity distribution the clean reconstructed silicon(lll)-7x7 surface is compared with the same surface that is covered with Ga. For high momentum transfers the intensities for the Ga-covered and clean surface deviate, which may be indicative of an ordering effect of the liquid. Due to the aforementioned problems with the beamline optics we could not detect weaker signals that arise from the small ordering effects in the liquid.

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(4) W.J. Huisman, J.F. Peters, J.W. Derks, H.G. Ficke, J.F. van der Veen, and D.L. Abernathy, in preparation.
(5) C. Norris and J.T.M Wotherspoon, J. Phys. F. 7 (1977) 1599.