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X-ray reflectivity on curved surfaces of molten copper covered with graphene film.

The X-ray reflectivity technique can provide out-of-plane electron-density profiles of surfaces, interfaces, and thin films, with atomic resolution accuracy. While current methodologies require high surface flatness, this becomes challenging for naturally curved surfaces, particularly for liquid metals, due to the very high surface tension. A method for X-ray reflectivity measurements on highly curved surfaces using 2D detectors is presented in this work. This method is applied to a solid surface with known curvature and to the in situ study of a CVD-grown graphene layer on molten copper at 1400 K having natural curvature due to the partial wetting of the tungsten substrate. Structural characteristics of the copper surface, the graphene layer, and the separation gap between them are obtained. It was found that the roughness of the bare liquid surface of copper at 1400 K is 1.25 ± 0.10 A, while the graphene layer is separated from the liquid surface by a distance of 1.55 ± 0.08 A and has a roughness of 1.26 ± 0.09 A. This method can be applied to any concave curved surface.

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Instrumentation and methods

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