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Properties of h-BN monolayer grown on curved Ni crystal: oxidation and oxygen intercalation

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Curving crystals to expose surfaces of variable orientation is a straightforward approach to explore appropriate templates and tunable substrates for 2D materials. It allows the systematic search and rational determination of an optimal growth substrate. A cylindrical crystal with a high-symmetry axis is the simplest curved geometry, but sufficient to span a full set of vicinal planes with close-packed steps. As demonstrated repeatedly, the cylindrical geometry is easy to handle and process in standard vacuum setups [1,2]. Moreover, it is particularly convenient for electron spectroscopies that make use of micron-sized photon beams in synchrotrons, such as Near-Edge X-ray Absorption and X-ray photoemission, since these can be scanned on the curved surface to smoothly probe different vicinal planes. Recently, we investigated the growth of h-BN on a Ni surface curved around the (111) direction [c-Ni(111)] [1]. We observed the formation of a well-defined, homogeneous h-BN monolayer all across the curved crystal, exhibiting an increasing presence of h-BN-covered micro-facets, as the surface plane tilted away from the (111) plane.
In the present study we systematically investigate the effect of thermal oxygen exposure of the h-BN monolayer interfacing a full variety of vicinal orientations around the Ni(111) high-symmetry direction [2]. Using Scanning Tunneling Microscopy, X-ray Absorption and Photoemission Spectroscopies we demonstrate the occurrence of two processes upon oxygen exposure: oxygen intercalation underneath the h-BN layer, which leads to decoupling of the h-BN from the substrate, and oxidation of h-BN itself, which proceeds via substitution of nitrogen atoms

References

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