Formation of Europium- transition metal surface compound and protection of Eu below hexagonal boron nitride (h-BN)

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Abstract
We have carried out a comparative analysis investigating the alterations in the electronic and structural properties of hBN when grown on curved transition metal (TM) substrates, particularly c-Pt(111) and c-Ni(111) crystals, both before and after Eu intercalation. The hBN was synthesized through CVD processes on these substrates. Numerous emerging devices are proposed to rely on 2D materials such as Graphene (Gr), hexagonal boron nitride (hBN), and others. These materials are generally grown by CVD processes on metal substrates such as copper, nickel, or platinum. The quality of growth significantly relies on both the crystallinity of the substrate and the interaction between the overlayer and the substrate. The characteristics of the interface can be altered by adjusting the crystal structure and step density of the substrate. This was demonstrated through the growth of hBN on curved crystals, where the substrate faceting varied between strong (Ni) [1], intermediate (Rh) [2] and weak (Pt) [3]. The structural properties were examined using Low-energy electron diffraction (LEED) and scanning tunneling microscopy (STM). Stable facets were observed to form during hBN growth on the substrates. However, after Eu intercalation, changes in the stable facets were observed. A formation of Eu-TM alloy is detected by the LEED. The electronic structure was characterized by X-ray photoelectron spectroscopy (XPS) and angle-resolved photoemission measurements (ARPES). Moreover, we explored the possible protective role of the hBN layer for Eu on both curved Pt(111) [4] and Ni(111) substrates. Overall, our observations suggest that the protection of Eu was incomplete, and this incompleteness varied along the curved crystals. Specifically, on c-Pt(111), better Eu protection was noted at the (111) surface compared to the steps. Conversely, on c-Ni(111), the opposite trend was observed. This variation could potentially be attributed to the influence of the mismatch between the hBN and the substrates. The incomplete protection of Eu due to defects and growth boundaries in the hBN layer led to the oxidation of Eu.

References

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Figures

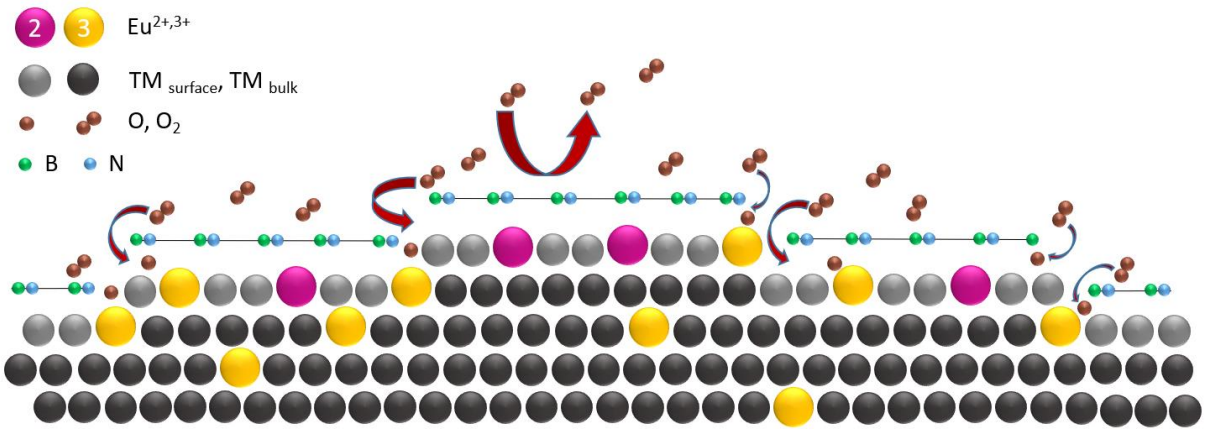

Figure 1: A schematic diagram depicts the exposure of an Eu-transition metal (TM) surface alloy beneath a protective layer of hBN to ambient conditions.