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

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We present a comparative study of the electronic and structural properties of hBN on curved and flat transition metal (TM) substrates, c-Pt(111), c-Ni(111), and Ir(111) crystals, and their modifications after Eu intercalation. The hBN was grown by CVD processes on these substrates.

Many new devices are proposed to be based on 2D Materials like Graphene (Gr), hexagonal boron nitride (hBN), dichalcogenides, etc. These materials are generally grown by CVD processes on adequate metal substrates like copper, nickel, or platinum. The growth quality depends strongly on the crystallinity of the substrate and the overlayer-substrate interaction. The properties of the interface could be influenced by tuning the crystal structure and step density of the substrate. That was shown by hBN growth on curved crystals that feature strong (Ni) [1], weak (Pt) [2] substrate faceting, and highly ordered nanostripes on Rh [3].

The structural properties were investigated by Low-energy electron diffraction (LEED) and scanning tunneling microscopy (STM). Stable facets are formed upon hBN growth on the substrates. After Eu intercalation, some changes are 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). Furthermore, we studied the possible protection of Eu by the hBN layer on a curved Pt substrate [4]. We observed that Eu protection was incomplete due to defects and hBN growth boundaries which resulted in the Eu oxidation.

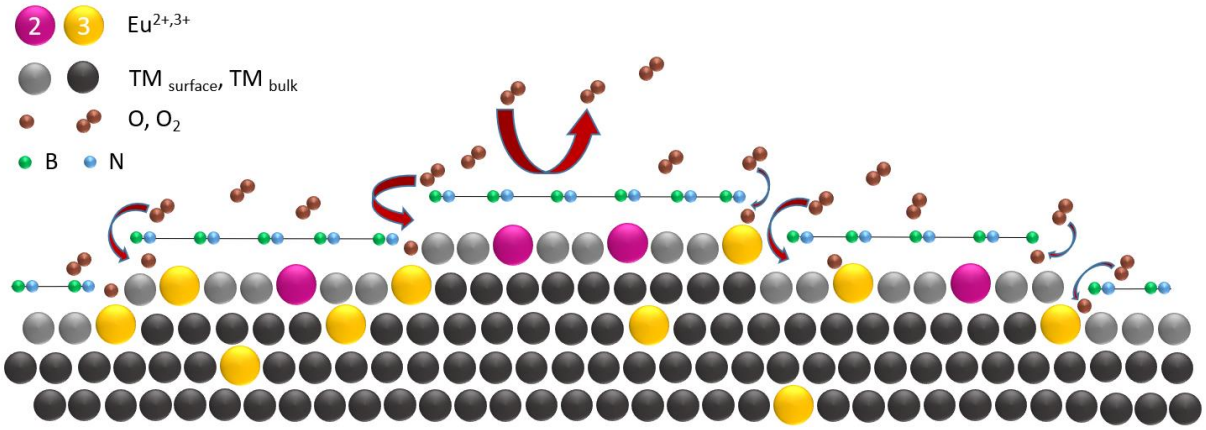

Fig. 1. Schematic diagram illustrates the exposure of an Eu-TM surface alloy below a protection layer of hBN towards ambient conditions.

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[2] Bakhit, Alaa Mohammed Idris, et al. Science Talks **4**, 100071 (2022).
[3] Ali, Khadiza, et al., Advanced Science **8 (17)**, 2101455 (2021)
[4] Bakhit, Alaa Mohammed Idris, et al. arXiv preprint 2301.11837 (2023).