The formation and protective behavior of a hexagonal boron nitride layer on platinum-type surfaces

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Abstract

A comparative study of the structural and electronic properties of hBN grown on flat and curved transition metal (TM) substrates such as Ir(111), Ru(0001), c-Pt(111), c-Pd(111), c-Ni(111) and c-Rh(111); and their modifications after Eu intercalation were explored.
Here, focusing on the curved platinum system, the experimental study was carried out in a two-step method: first, conducting systematic investigations of the mechanisms involved in forming Eu-TM alloy surface compounds below hBN. For the hBN/Eu/Pt(111) system, a ferromagnetic surface compound was detected. Furthermore, the possible protection of the ferromagnetic Eu-Pt alloy was examined, through a protective monolayer of hBN [1]. The second part was dedicated to performing a comparative analysis of the electronic and structural characteristics of hBN when grown on various transition metal (TM) substrates, in particular, the B-type vicinal surfaces extend a range between Pt(110) and Pt(111). Five stable facets after hBN growth were distinguished, namely (110), (111), (221), (441), and (991) [2].
Experimentally, the structural properties were characterized using low-energy electron diffraction (LEED) and scanning tunnelling microscopy (STM), while the electronic properties were analyzed using x-ray photoelectron spectroscopy (XPS), near-edge x-ray absorption fine structure (NEXAFS) and angle-resolved photoemission (ARPES).
To better understand the formation of the stable surface facets, Density Functional Theory calculations were performed to explore the structural and electronic properties of hBN on the experimentally stable facets.

These investigations should help to build future spintronics devices incorporating 2D material layers such as graphene and hexagonal Boron Nitride with a ferromagnetic layer underneath.

References

[1] Bakhit, Alaa Mohammed Idris, et al. Nanoscale, 15.27 (2023), 11517-11528.

[2] Bakhit, Alaa Mohammed Idris, et al. Science Talks, 4 (2022), 100071.