Tailoring the hexagonal boron nitride nanomesh on Rh(111) by gold

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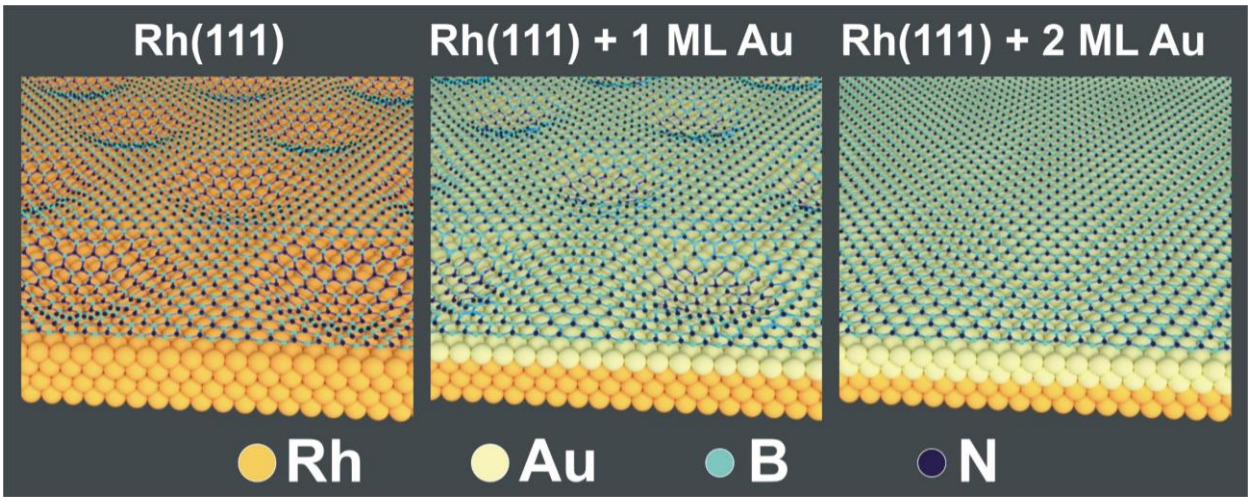
Graphene-like two dimensional (2D) materials such as the hexagonal boron nitride (h-BN) have attracted the scientific community with their exceptional properties and many potencial applications in diverse areas [1]. The h-BN monolayer has a periodically corrugated structure on Rh(111), termed as “nanomesh”, however, it becomes planar on close packed surfaces of the copper group due to their significantly weaker interaction. In this study we focus on the understanding of the interaction between metal surface and h-BN, when both Rh and Au are present.

We studied both (i) the growth and thermal properties of gold deposited on h-BN nanomesh prepared on Rh(111) and (ii) the formation of h-BN on Au/Rh surface alloys prepared by the deposition of Au on Rh(111) followed by annealing at 1000 K. In each case, the h-BN was prepared by the decomposition of borazine at about 1000 K. Low energy ion scattering (LEIS), X-ray photoelectron spectroscopy (XPS) and scanning tunneling microscopy (STM) measurements revealed that the growth of Au on h-BN/Rh(111) at room temperature leads to the formation of mainly three dimensional (3D) gold nanoparticles, although at low coverages (< 0.2 ML) 2D particles formed. Stepwise annealing to higher temperatures induces the intercalation of Au below the nanomesh, which was complete at around 1050 K. Some agglomeration and desorption of Au also took place. Interestingly, the nanomesh structure was observable after intercalation up to relatively large Au coverages. Measurements performed in the reverse order, namely exposing a Au/Rh(111) surface alloy to borazine, revealed that Rh atoms get covered by h-BN (or by its precursors) at significantly smaller borazine exposures than Au atoms. The nanomesh structure was essentially present up to a gold coverage of approximately ~1 ML, but with a smaller pore diameter, while it gradually disappeared at higher gold amounts. This way the application of surface alloy supports provides a key for gradual tuning of the mesh morphology



References:
[1] Wang, J.; Ma, F.; Sun, M. RSC Adv, **7** (27), 1680 (2017).