Ciclo de charlas

Interaction of metals with the hexagonal boron nitride monolayer studied on Rh(111)

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Two dimensional monolayers (MLs) of hexagonal boron nitride (h-BN) are promising insulator components for nanoelectronics. The h-BN monolayer has a similar structure and lattice constants as those of graphene. On Rh(111) surface, monolayer h-BN forms a periodically corrugated surface structure, called "nanomesh". This phenomenon allows its application as a nanotemplate.

Here we report on the growth of gold and rhodium on the h-BN/Rh(111) surface and on subsequent thermal effects studied by STM, XPS and LEIS. The latter technique reveals the elementary composition of the outermost atomic layer. The h-BN monolayer was formed on Rh(111) by the decomposition of borazine (BAz) at high temperatures (1000 K). Gold forms 1-2 atomic layer thick nearly 2D nanoparticles, when it is evaporated in small amounts (~0.15 ML) on the nanomesh at 300 K. At higher coverages, the growth is strongly 3D. The gold peak was observed at a rather low position (83.7 eV), indicating significant electronic interaction either with h-BN. Indeed, previous density function theory (DFT) calculations indicated an electron transfer from boron nitride to gold. The intercalation of gold is the dominant process upon stepwise thermal annealing to 1050 K, but agglomeration and evaporation also occur to a limited extent. Interestingly, though gold and rhodium form a surface alloy after intercalation, the presence of ~0.15-0.50 ML of Au below the h-BN layer does not significantly influence the nanomesh structure. At higher gold doses a partial or full flattening of the nanomesh was observed. Surface alloying of gold and rhodium and the interaction of these metals with the h-BN layer are addressed with DFT calculations as well.

We also investigated the growth of h-BN on Au-Rh alloyed surfaces varying the gold content until 4 ML. In these measurements gold was evaporated on Rh(111) at 500 K, followed by annealing at 1000 K for 5 min. Subsequently, the surface was gradually exposed to BAz at 1000 K. The exposure was increased until the whole metal surface was covered by h-BN, as shown by LEIS, but not above 260 L. Decomposition of BAz on the alloyed surface led to the attenuation of both Rh and Au LEIS (normalized) intensities and Au signal slowed down with increasing Au content. It was shown by STM measurements that up to a gold coverage of 0.5 ML, the nanomesh structure is only slightly disturbed, but larger parts are flattened at higher Au doses. LEIS studies on the growth of rhodium on h-BN/Rh(111) indicated a predominantly 3D growth, similar to the gold case. When small amounts of rhodium (up to 1 ML) were deposited on h-BN/Rh(111), intercalation was nearly complete upon annealing to ~900 K, while dewetting of the h-BN layer set in at ~1050 K. At higher rhodium doses, complete intercalation could not be reached at any temperatures.

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