Nanostructured surfaces

Interaction of oxygen with supermonolayer beryllium films on the Mo(112) surface

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Beryllium is a metal which can find important application in construction of thermonuclear reactors. In this work, adsorption interaction of oxygen with supermonolayer beryllium films formed on the Mo(112) surface at the coverage degrees θ_{Be}=3.3-3.8 has been investigated. Contrary to the submonolayer and monolayer films of Be on Mo(112) which coat the substrate surface only partially and provide abilities of some Mo atoms to interact directly with oxygen, the Be films of a coverage exceeding θ_{Be}=2.44 coat the substrate with a complete shell which adsorbs oxygen. Using Auger electron spectroscopy, low-energy electron diffraction and contact potential difference techniques, we have found that oxygen chemisorption on such surface proceeds with the initial sticking coefficient $s_0 \approx 0.3$ which significantly exceeds that specific to the O/Be system ($s_0 \approx 0.01$). Thus the Be film of the mentioned thickness does not yet possess the electronic property of the bulk beryllium metal.

Oxygen adsorption at room temperature is accompanied with BeO synthesis like in the case of interaction of oxygen with the Be submonolayers. The synthesis process accelerates under annealing in the range of 300-1000 K. The synthesized oxide coverage decreases the work function by 1-1.2 eV evidencing formation of a positive electrical double layer on the surface. No structural ordering has been observed under annealing to 300-800 K. That may be caused by the incommensurability between the lattices of BeO and still non-oxidized Be coverage which remains partially on the Mo(112) surface.

In result of annealing to 1200-1400 K, the remnants of non-oxidized beryllium desorb while more refractory BeO remains on the surface. LEED patterns obtained from such overlayer correspond to an ordered film structure identified as the pseudomorphic one. Probability of formation of the BeO structure commensurate with the Mo(112) is discussed. The mentioned annealing procedure provides production of beryllium oxide coverage free of Be.