Formation of grapheme and graphite on the surface of rhodium

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In this work studied the interaction of carbon with the surface of rhodium (111) in UHV conditions by means of Auger electron spectroscopy in a wide range of temperatures 300-1800 K. The camera of device had a module to diagnose the surface by thermionic emission and surface ionization of probing streams of CsCl atoms or molecules.

The samples were rhodium tape size (1×0.03×40) mm^3, which was purified from possible impurities by heating in an atmosphere of oxygen (PO_2~$1\cdot10^{-5}$ Torr) at T = 1800 K. After purification, were observed only Auger peaks of rhodium. Tape surface was homogeneous with respect to the work function and had eφ = 4.95 eV, which corresponded to the (111). Relative area of the islands of graphene determined by probing the surface molecules of CsCl [1].

As a source of carbon used in the admission chamber vapors of benzene to PC_6H_6~$2\cdot10^{-6}$ Torr. At a sample temperature T>1000K benzene dissociated hydrogen desorbed, and carbon dissolved in the bulk metal. After saturation of rhodium with carbon on the surface were formed islands of graphene, which grew in size, merged and formed a continuous graphene film - with the dissociation of benzene on the passive surface of graphene was stopped and the film thickness in excess of one graphene layer is not increased. In the formation of islands of graphene surface is heterogeneous on the work function: the work function of islets was equal eφ = 4.35 eV and work function areas free from islands remained equal eφ = 4.95 eV. In the formation of a continuous layer of graphene surface again becomes uniform to work out - eφ= 4.35 eV.

Interesting results are obtained when the temperature carbonized sample. If the temperature T_c carbonization rhodium is raised stepwise, the graphene layer broke up into islands, and for each T=const there was a dynamic equilibrium, when the area of the islands has not changed over time - in this case, the flux of carbon atoms from the edges of graphene islands amounted to a stream of atoms coming from the “gas” adsorbed phase on the islands. The range of equilibrium graphene islands was 100°. At $T>T_c$+100° graphene islands are completely destroyed and remains on the surface only chemisorbed carbon "gas" with a concentration of ~$4\cdot10^{14}$ at/cm^2 (T_c=1400 K).

Return to the temperature $T=T_c$ quickly restores a continuous layer of graphene. If the sample temperature is lowered to $T<T_c$, tone the surface grows thicker graphite layer by allocating the excess C atoms from the bulk of the supersaturated solid solution of Rh-C. The film thickness can reach several tens of layers [2].

[1] E.V.Rut'kov, A.Yn. Tontegode, *Surface Science* **161**, 373 (1985).
[2] Rut’kov E.V., Kuzmichev A.V., Gall’ N.R. *Phys. Solid State*, In press.