

The abstract of PhD thesis:

Electronic structure of ultrathin Au films on Si substrate

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The aim of this dissertation is determination of the crystallographic and electronic structures of gold films deposited on the silicon substrate for the Au thickness in the range of several atomic layers. The study has been performed using following experimental techniques: scanning tunnelling microscopy (STM), reflection high energy electron diffraction (RHEED) and angle resolved photoelectron spectroscopy (ARPES).

One of the main thesis of this dissertation is preparation of a model of gold layer on the Si(111) substrate. The gold film consists of uniform height Au crystallites with the same orientation with respect to the silicon substrate. A fraction of the layer is composed of Au(110) crystallites with the (110) plane parallel to the Si surface. Those crystallites form a texture with no preferred azimuthal orientation. They are covered with gold silicide having the rectangular symmetry. ARPES results reveal the presence of discrete states in the electronic structure whose position and shape vary with the thickness of the Au layer. Those states are associated with quantum size effect and prove good quality of the gold layer: sharp interfaces between the substrate and layer and a uniform height of Au crystallites.

The work also includes the results obtained for the Au/Si system annealed at higher temperatures (above 500 K). The obtained data indicate on the appearance of a new structure with a honeycomb symmetry on the surface of the Au crystallites. The electronic structure consists of bands with linear dispersion. Those states may indicate the presence of massless Dirac fermions. The most probable hypothesis explaining those results is the presence of silicene (silicon equivalent of graphene) on the surface of gold film.

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