Dirac Fermions in Si-Au Heterostructures

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Silicene, the silicon counterpart of graphene, is a one-layer thick two-dimensional material, in which Si atoms form a honeycomb lattice [1]. Its freestanding atomic structure is low-buckled, although completely flat (planar) form has also been predicted [2]. Similarly to graphene, both forms of silicene are characterized by the presence of linear Dirac bands in the electronic structure. Until now, silicene has been synthesized in the epitaxial form only on a few, mainly metallic, substrates with significantly changed structural and electronic properties [3].

Recently, the planar silicene has been synthesized on Au(111) films grown on Si(111) substrate in the process of surface segregation [4]. Its electronic structure is different than in the case of the freestanding form. Nevertheless the linear bands do exist, although they exhibit more complex dispersion patterns in the Brillouin zone. The presence of such exotic Dirac fermions originates from the silicene-substrate interaction. This planar form of silicene is a part of a more complex Si-Au heterostructure with twisted atomic layers [5]. The morphology of the substrate plays a substantial role in the synthesis of the planar silicene, as shown in Fig. 1.

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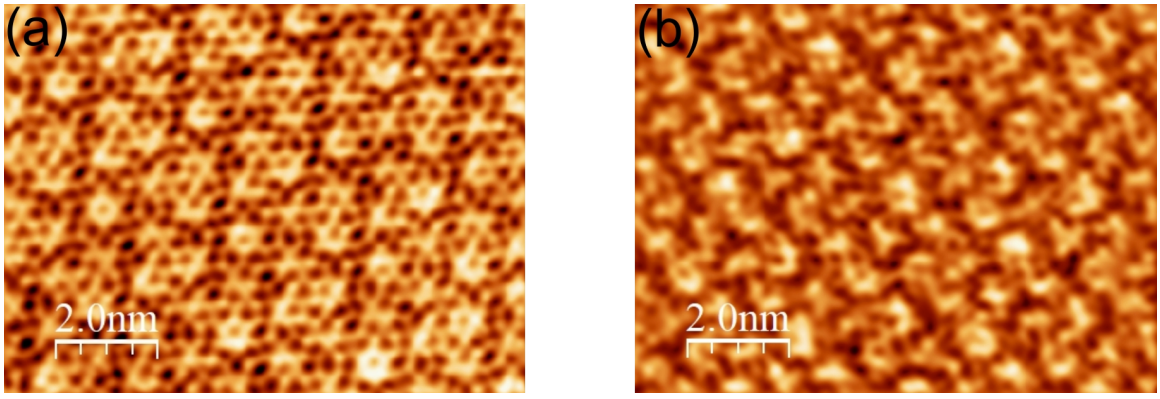

Fig. 1. STM topography of the planar silicene synthesized on flat Si(111) (a) and vicinal Si(11 11 13) substrate (b).

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