# Features of the electronic structure of graphene on top of different substrates

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Investigation of the graphene monolayer have attracted considerable intereSt in recent years due to its unusual electronic structure (linear "photon-like" dispersion of electron states near the Fermi level in the region of the K-point of the Brillouin zone) and related to this its unique transport properties. So far the only feasible route toward large-scale production of graphene is epitaxial growth on a substrate. The presence of the substrate will, however, influence the electronic properties of the graphene layer. The main aim of our work was investigation of principal features of electronic properties which appear as the result of the interaction of the graphene layer with different substrates.

In the present work the electronic structure of such systems as 1ML graphene on top of Ni(111), SiC(0001), Cu/Ni(111) and Au/Ni(111) was studied [1]. All this data was compared with each other and with electronic structure of bulk monocrystalline graphite. Systems were investigated by angle-resolved photoelectron spectroscopy (ARPES) with the application of synchrotron radiation.

The analysis of dispersion relations of graphene on top of intercalated Au and Cu layers shows that hybridization of d states of Au and Cu with π states of graphene takes place. This hybridization leads to modification of dispersion relations in the region of crossing of these states. Gaps of dispersion relations and the bonding and the antibonding (d - π)-states above and below the gap are formed. For graphene formed on top of Ni(111), covalent interaction of π states with d states of Ni substrate is stronger. It leads to the shift of π-states about 2 eV in comparison with those of bulk graphite [2]. Unoccupied π*-states are located above Fermi level and only bonding π-states are occupied, therefore the interaction of graphene with Ni(111) substrate is very strong.

In some systems besides covalent interaction ionic bond is existed, i.e. charge transfer from atoms of metal to graphene monolayer takes place. For instance, for systems MG/Cu/Ni(111) and MG/SiC(0001) there are partial occupation of unoccupied earlier π*-states at Fermi level near the K point of the surface Brillouin zone of graphene.

[1] A. Varykhalov et al., *Phys. Rev. Lett.* **101**, 157601 (2008).
[2] Th. Seyller et al., *Surf. Sci.* **600**, 3906 (2006).