Electronic structure of graphene-related nanosystems

Usachov D.*, Adamchuk V.K.*, Shikin A.M.*, Marchenko D.*, Brzhezinskaya M.*, Varykhalov A.**, Rader O.**

** Physical Faculty of St. Petersburg State University, St. Petersburg, 198504, Russia*
*** BESSY, 12489 Berlin, Germany*

Graphene is considered to be a perspective material for applications in nanotechnologies [1]. It can be synthesized on different substrates but the substrate can have a substantial influence on its electronic and crystal structure [2]. Graphene having nearly ideal crystal structure can be synthesized on Ni(111) surface. But its electronic structure is significantly affected by interaction with substrate. This interaction can be weakened by intercalation of different metals underneath graphene layer [3]. Here we report the results on intercalation of several metals, such as Au, Ag, Cu, Al, and show differences in the electronic structure of graphene in the synthesized systems. We showed that in the particular case of gold intercalation quasifreestanding graphene can be formed, which is confirmed by the occurrence of the Dirac point at the Fermi level, monitored by angle-resolved photoelectron spectroscopy (ARPES) [4]. If we go from Ni(111) to Ni(110) substrate, the electronic and crystal structure of graphene changes significantly. Here we present the results of ARPES investigation of the graphene/Ni(110) system.

Graphene is a two-dimensional crystal and it is of a great interest to reduce its dimensionality to get new systems with interesting properties. If we do this we get carbon clusters or molecules. And here a question arises: how the electronic structure of graphene-derived clusters or molecules is related to the graphene electronic structure? In this work we present the results of investigation of the electronic structure of pentacene molecules on the Ni(110) substrate and its comparison with the electronic structure of the graphene/Ni(110) system. Pentacene molecule ($C_{22}H_{14}$) can be considered as a small graphene stripe. The symmetry of the Ni(110) substrate allows formation of an ordered layer of pentacene molecules, oriented in one direction. This gives a possibility to use ARPES for band structure determination. The investigation of a saturated pentacene monolayer showed that in the direction along molecules evident dispersion of pentacene states is observed. The dispersion in its shape and position is close to the dispersion of the pi-states of graphene on Ni(110).

This work was supported by RFBR projects 08-03-00410, 09-08-01088.

[1] K.S. Novoselov et al., Science 306, 666 (2004).
[2] D. Usachov, A.M. Shikin, V.K. Adamchuk, et al., *Phys. Rev B* **78**, 085403 (2008).
[3] D. Farias, A.M. Shikin, V.K. Adamchuk, et al., *Surf. Sci.* **454-456**, 437 (2000).
[4] A. Varykhalov et al., *Phys. Rev. Lett.* **101**, 157601 (2008).