POLARIZATION DOPING AND WORK FUNCTION OF EPITAXIAL GRAPHENE ON SILICON CARBIDE

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Epitaxial graphene grown on SiC surfaces is a promising material for electronic applications such as chemical sensors, THz detectors, quantum resistance standards, etc. The close contact with the substrate has consequences on the properties of graphene. In particular, the epitaxial graphene layers exhibit a characteristic charge carrier density, which can be measured by angle-resolved photoelectron spectroscopy as seen for example in figure 1. The charge carrier density is given by $n = g_S \cdot A_F / A_{BZ}$, where A_F and A_{BZ} = 7.56 $Å^{-1}$ are the area of the Fermi surface and the area of the first Brillouin zone in reciprocal space, respectively. $g_S = 2$ is the spin degeneracy. The observed behavior can be explained by interface states, doping of the SiC substrate, and the spontaneous polarization of the SiC substrate [1,2]. Using different polytypes of SiC (cubic 3C and hexagonal 4H and 6H), as well as low-doped (semi-insulating) and highly doped substrates, it is possible to confirm the model.

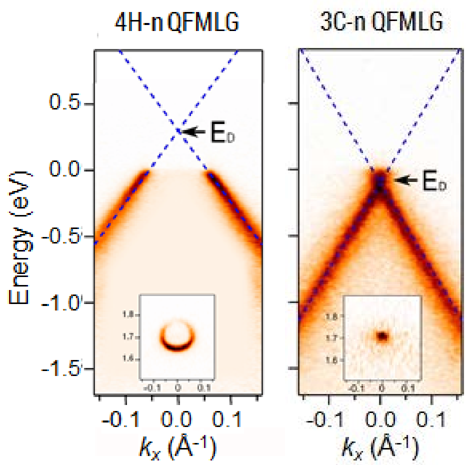

Fig. 1: π-bands of graphene on hydrogen-terminated, n-type 4H-SiC(0001) and 3C-SiC(111) probed by ARPES in the vicinity of the K-point of the hexagonal Brillouin zone. The position of the Dirac point E_D is marked.

Besides the substrate induced doping of graphene, its work function is of great importance to understand for example the behavior of contacts and for designing electronic devices. We have determined the work function of single layer and multilayer epitaxial graphene on SiC(0001) using Kelvin probe measurements as well as photo yield measurements. The results indicate that the work function of these systems is directly coupled to the charge carrier density, approaching the value of graphite for increasing layer numbers and charge neutrality.

Keywords: Graphene; silicon carbide; intercalation; doping; work function.

References

[1] J. Ristein, S. Mammadov, Th. Seyller, Phys. Rev. Lett. 108 (2012) 246104.
[2] S. Mammadov, J. Ristein, R.J. Koch, M. Ostler, C. Raidel, M. Wanke, R. Vasiliauskas, R. Yakimova, and Th. Seyller, 2D Mater. 1 (2014) 035003.