The theoretical study of the atomic and electronic structure of graphene biribbons

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The emergence of graphene as a stable pure two-dimensional system has been one of the most important events in electronic condensed matter physics over the last years [1]. Until recently, the 2D paradigm was limited mostly to electrons confined to quantum wells or inversion layers in semiconductor heterostructures. The situation changed when it was found that individual atomic planes could be pulled from a graphite crystal.

One of many interesting properties of graphene is the Dirac type of electronic band structure and the drastic changes of the conductivity of graphene-based structures with electron confinement. Thus, two possibilities for the realization of this effect have been proposed: carbon nanotubes (periodic boundary conditions for the wave-vector of the electron) and graphene ribbons (finite-width graphene strips - zero boundary conditions).

Shortly after the isolation of graphene it was found that the electronic structure of few layered graphene strongly depends from the number of layers. Here we raise the question: how the electronic structure of the graphene ribbons changes with increasing number of the layers?

We studied the different compositions of the biribbons. The electronic structure of AGR+AGR, ZGR+ZGR and AGR+ZGR biribbons was obtained. The parallel and perpendicular relative orientations of the ribbons were studied. In the case of the non-parallel orientation of the ribbons the appearance of the quantum dot was found. A possible application of the biribbons in the nanoelectronics was discussed.

References:

[1] K. S. Novoselov, A. K. Geim, S. V. Morozov, D. Jiang, Y. Zhang, S. V. Dubonos, I. V. Grigorieva, and A. A. Firsov, Science **306** (2004) 666.