Electronic Properties of Corrugated Bilayer Graphene

M. Pelc [1,2], W. Jaskólski [1], A. Ayuela [2,3] and L. Chico [4]

[1] *Wydział Fizyki, Astronomii i Informatyki Stosowanej, Uniwersytet Mikołaja Kopernika, Toruń, Polska*
[2] *Centro de Física de Materiales, CFM-MPC CSIC-UPV/EHU, Donostia International Physics Center (DIPC), San Sebastian, Spain*
[3] *Departamento de Física de Materiales, Facultad de Químicas, UPV-EHU, San Sebastian, Spain*
[4] *Instituto de Ciencia de Materiales de Madrid (ICMM), Consejo Superior de Investigaciones Científicas (CSIC),Madrid, Spain*

The bilayer graphene in a semiconductor with a zero-energy gap. In the experimental measurements of conductance, however, a transport gap of a few meV may appear. One of the explanations is the appearance of the small surface corrugations that may cause the drop of conductance [1,2].

Here we investigate the bilayer graphene and nanoribbons with the Bernal stacking having single or multiple corrugations. We perform tight-binding calculations using Green function matching technique to study the transport and electronic properties.

The conductance calculations across the corrugations show, indeed, that the fold in one layers may lead to the transport gap although only if it causes the stacking change from AB to BA. The origin of the conductance drop is the symmetry change between these two types of lattice stackings.

In the system with the gate voltage applied, that opens a conductance gap, we observe the topologically protected localized states bounded to the corrugation region [3]. In the case of large corrugation more localized states appear. These originate from the eigenstates of the long fold.

The analysis of the local density of states (LDOS) shows that these states localize mostly around the corrugation region and decay in the bilayer leads with the oscillatory character. This behavior and its dependence on energy is explained with the complex band structure (CBS) calculations. Although, due to their localized character, these states give no contribution to the conductance across the corrugation, they may show a conductive behavior along the corrugation.

[1] P. San-Jose, R. V. Gorbachev, A. K. Geim, K. S. Novoselov, F. Guinea - *Nano Lett.*, **14**, 2052 (2014);
[2] M. Koshino - Phys. Rev. B **88**, 115409 (2013);
[3] A. Vaezi, Y. Liang, D. H. Ngai, L. Yang and E.-A. Kim - Phys. Rev. X **3**, 021018 (2013);