Tuning transport properties on graphene multiterminal structures by mechanical deformations

Vanessa Torres1, Daiara Faria2, Andrea Latg3

1MackGraphe, Mackenzie Presbyterian University, SP-Brazil, 2Instituto Politécnico, Univ. do Estado do Rio de Janeiro, Nova Friburgo, RJ-Brazil 3.Univ. Federal Fluminense, Niterói, RJ-Brazil

Mechanical deformation on graphene may be modeled as hopping modifications between first neighbor atoms, leading to an effective gauge field in the continuum description, which generates changes in the electronic properties of the system. Deformation on graphene, such as bubbles and wrinkles, may appear spontaneously or can be controlled by different experimental setups. Recently, banding gap engineering and valleytronics based on mechanical deformation has been explored on graphene layers and also on graphene nanoribbons [1,2], which gives the possibility of tuning electronic and transport responses. With this motivation we investigate the effect of the out-of-plane deformations on the electronic and transport properties of graphene nanostructures connected to electronic multi-terminals. Specifically, we consider hexagonal and triangular graphene flakes, with armchair and zigzag edges. Graphene flake systems were studied taking into account three types of mechanical out-of-plane deformations: Gaussian-like and fold-like. We considered a first neighbor tight-binding approach and the linear elasticity theory. The conductance and electronic density of state were carried out by using the Landauer-Büttiker formalism and recursive Greens function method for a multiterminal system [3]. We show that at lower energies, resonant levels are more impressive for hexagonal than triangular flakes, while the electronic transport of triangular flakes is more sensible to deformations extended to the leads.

[1] V Torres, C Leon, D Faria, and A Latge. Gap engineering in strained fold-like armchair graphene nanoribbons. Physical Review B, 95(4):045425, 2017.
[2] Ramon Carrillo-Bastos, C León, D Faria, A Latgé, Eva Y Andrei, and N. Sandler. Strained fold-assisted transport in graphene systems. Physical Review B, 94(12):125422, 2016.
[3] G. Thorgisson, G. Viktorsson, S.I. Erlingsson, Recursive Green’s function method for multi-terminal nanostructures, Journal of computation Physcs, 261, 256-266 (2014).