Electronic transport in a deformed graphene kirigami

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Influenced by the Japanese art of cutting paper called kirigami, graphene nanostructures have been designed and experimentally tested. These graphene kirigamis are robust and present incredible high stretchability rates (~ 240%)[1]. In this work [2] we use a combined molecular mechanics + tight binding approach to calculate the electronic and transport properties of graphene kirigamis similar to those studied in the experiments.

A kirigami like the one shown in Fig. 1 presents four deformation stages [3], however, we only focus on elastic and reversible deformations (first two stages). The conductance of the undeformed kirigami in Fig. 2 presents minibands originated by the coupling among the localized states in different sections of the kirigami. When tensile load is applied, the kirigami is deformed and the coupling among the localized states is reduced, this is seen in Fig. 2 for deformations of 5.3% and 15,5%, where the minibands in the conductance are replaced by isolated peaks. Based on the above a progressively reduction of the conductance would be expected for larger deformations. However, resonant transmission is revived for deformations of 25.1% and 34.7%. Using LDOS and strain maps we associate the conductance revival with additional confinement created by strain barriers. We will also show the I-V characteristics and the effect of dephasing processes. DAB acknowledges support from FAPESP grant 2012/50259-8.

References

[1] M. K. Blees, *et al*, Nature 525 (2015) 204
[2] D. A. Bahamon, *et. al*, Phys. Rev. B, 93 (2016) 235408.
[3] Zenan. Qi, *et al,* Phys. Rev. B, 90 (2014) 245437.

Figures

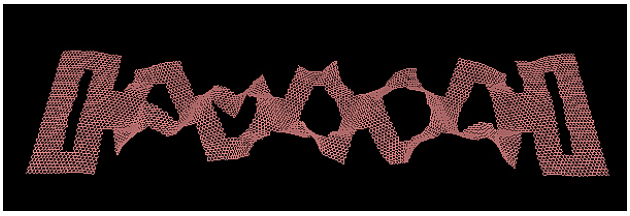

Figure 1: Molecular Dynamics simulation of a Graphene kirigami deformed 15%.

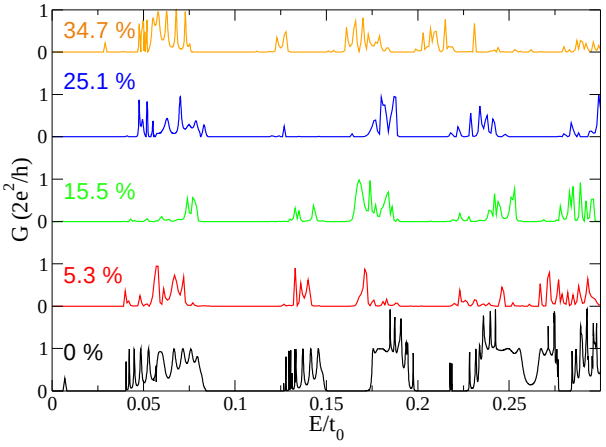

Figure 2: Conductance of the graphene kirigami for different values of deformation.