Electronic Transport Across Graphene Nanoribbon Junctions

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Graphene nanoribbons (GNRs) are considered promising candidates for all-graphene integrated circuits of nanoscale dimensions due to the possibility of controlling a broad range of electronic properties by bottom-up chemical self-assembly. Junctions connecting two or more GNRs are essential components for building such circuits and hence clear understanding of their electrical characteristics is critical. We have explored numerous GNR nanostructures containing quantum-dots[1], integrated metal-semiconductor-metal junctions[2] as well as defective nanoribbons[3]. Additionally, extensive screening of hundreds of thousands of disctinct configurations with numerical calculations [4] based on the tight-binding Hamiltonian and the Green's function formalism allowed us to define rules for desining junctions with minimal scattering for potential use as interconnects in nanocircutry. Analysis of these results reveals the underlying structure-property relationships with crucial roles played by the bipartite symmetry of graphene, localized resonant states and geometry of the GNR junctions. Overall, our work defines the guidelines for engineering GNR junctions with desired electrical properties.

References

[1] K. Čerņevičs, M. Pizzochero, and O. V. Yazyev, Eur. Phys. J.Plus.135 (2020) 681
[2] K. Čerņevičs, O. V. Yazyev, and M. Pizzochero, Phys. Rev. B 102 (2020) 201406
[3] M. Pizzochero, K. Čerņevičs, G. B. Barin, S. Wang, P. Ruffieux, R. Fasel, and O. V. Yazyev, 2D Mater. 8 (2021) 035025
[4] K. Čerņevičs, V. Granata, and O. V. Yazyev, Materials Cloud Archive 2020.66 (2020), doi: 10.24435/materialscloud:av-24

Figures

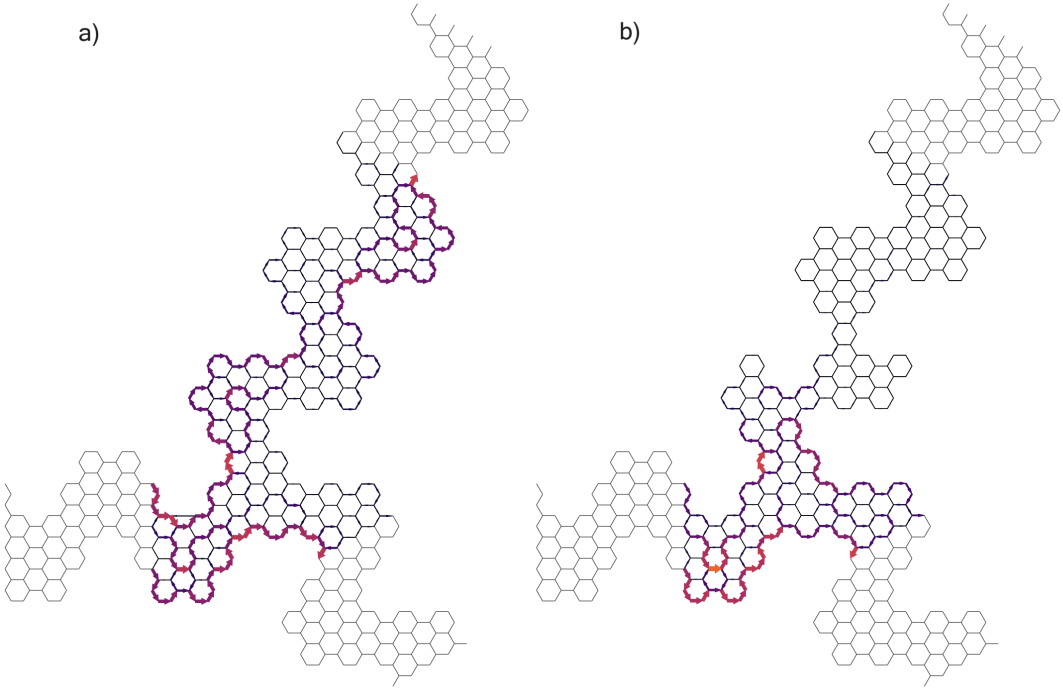

Figure 1: Local probability current in two GNR triple-junctions a) with and b) without a "bite" defects