Electronic transport, nanostructuring and disorder in graphene

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Abstract
Nanoscale patterning has been suggested as a possible route towards achieving the elusive electronic band-gap required to incorporate graphene, with its many superlative properties, into conventional semiconductor devices. Of particular interest are so-called *graphene antidot lattices (GALs),* consisting of sheets of graphene with periodic perforations, which theory predicts should display sizable band-gaps[1]. In this talk I demonstrate that the geometric disorders inherent in fabrication techniques severely hamper the performance of many GAL-based devices. Furthermore, control over antidot edge geometry may allow the detrimental effects of such disorders to be minimised[2].
I will also discuss techniques we have developed to characterize individual defects and nanostructures using multiple point-probes or STM tips. Computational methods developed to extend this type of analysis from simple defects to larger nanostructures such as perforations or gas-filled blisters will be demonstrated[3].
Finally, I will discuss two alternative routes towards achieving desirable electronic properties in graphene, namely bilayer systems with single layer nanostructuring[4] and graphene with selective sublattice doping[5].

References
[1] Pederden, T. G. et al, Phys. Rev. B, **77** (2008) 245431
[2] Power, S. R. and Jauho, A.-P., Phys. Rev. B, **90** (2014), 115408
[3] Settnes, M. *et al*, preprint arXiv:1501.06036 (2015)
[4] Gregersen, S. S. *et al*, preprint arXiv:1410.5196 (2015)
[5] Aktor *et al*, *in preparation* (2015)

Figures

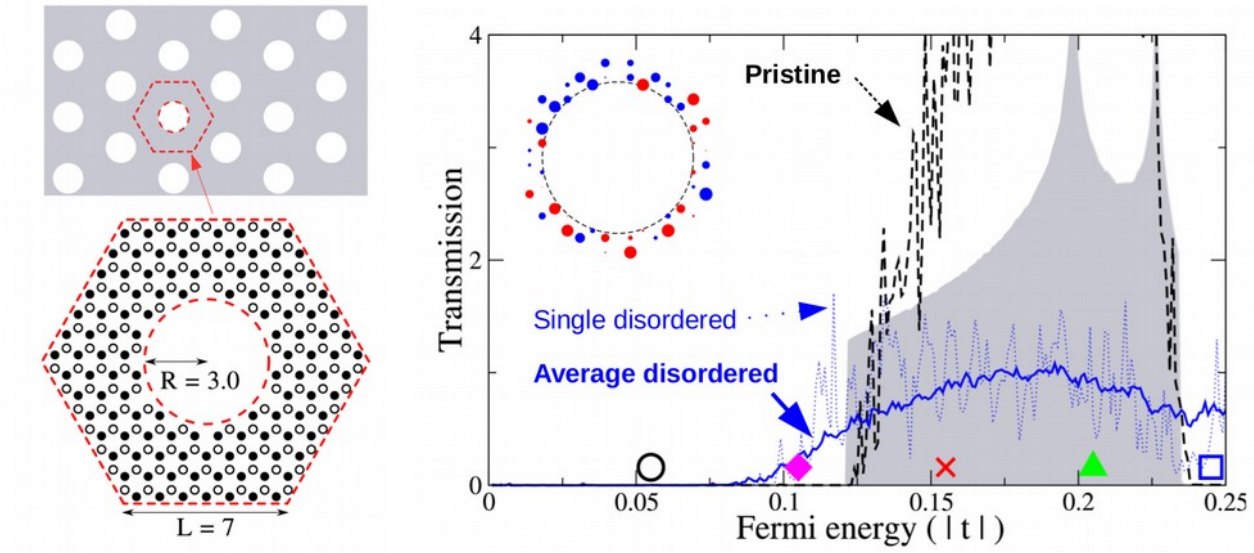

Figure 1: (Left) Schematic of graphene patterned with circular antidots arranged in a triangular superlattice, showing the unit cell of the {7,3} antidot lattice system.
(Right) Transmission through finite-width antidot barriers for the pristine case, and with edge roughness disorder in the form of weak random potentials on the antidot edge sites (shown for a single instance and for configurationally averaged disorder)