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Graphenes with nanoholes and CH(CF) nanoislands – comparison of analogous structures and similar electronic properties, applications

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Abstract

Thanks to its high charge carrier mobility graphene is expected to emerge as an excellent material for radiofrequency electronic applications. Despite of many fascinating properties, the semimetallic nature of graphene complicates the application in the semiconductor nanoelectronics. In the recent years a number of ways to open a gap of graphene was proposed. Recently it has reported the fabrication of a new graphene nanostructures called a graphene nanomesh (GNM), in which the size of nanoholes and the distance between them can be controlled down to the sub-10 nm scale. Various techniques have been developed to produce such GNM lattices, such as block colopymer lithography, nanosphere or nanoimprint lithography, and using nanopore aluminum [1]. Earlier analogical periodic graphane-graphene (and CF-graphene) structures have been discussed in various papers (see, for example, [2]).

Hear we review and compare similar geometries and properties of graphene structures with periodic graphane (or carbon fluoride) nanoislands and nanoholes: GNM (or G-CH, G—CF) structures with hexagon, square, triangle, and rhomb holes (or CH, CF islands).

We consider:

1. Nanomeshs of single graphene layer.
"Metallic" and semiconductor behaviors of "zig-zag" and "armchair"-like periodic rectangular structures.
1.2. Special GNMs as quantum dots: structures and properties.
1.3. Magnetic properties of GNM with zigzag C-edges of holes.
2. Nanomeshs of bi-layer graphenes
2.1. BGNM structures with all sp2-carbon atoms (layer bonds via topological defects).
2.2. BNNM structures with H- and F- atoms adsorbed on borders of holes.
2.3. Mechanical properties of BGNMs.
3. Applications of GNMs.
3.1. Holes in graphene for diagnostic DNA and bio molecules.

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