Quantum Interference Engineering of Nanoporous Graphene for Carbon Nanocircuitry

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Bottom-up prepared carbon nanostructures appear as promising platforms for future carbon-based nanoelectronics due to their atomically precise and versatile structure.**[1]** An important breakthrough is the recent preparation of nanoporous graphene (NPG) as an ordered covalent array of graphene nanoribbons (GNRs, **Figure 1a**).**[2]** Within NPG, the GNRs may be thought of as 1D electronic nanochannels through which electrons preferentially move, highlighting NPG's potential for carbon nanocircuitry. However, the π-conjugated bonds bridging the GNRs give rise to electronic crosstalk between the individual 1D channels, leading to spatially dispersing electronic currents (**Figure 1b**).**[3]** In this talk, we propose a chemical design of the bridges resulting in destructive quantum interference (QI), which blocks the crosstalk between GNRs in NPG, electronically isolating them. Our multiscale calculations reveal that injected currents can remain confined within a single, 0.7 nm wide, GNR channel for distances as long as 100 nm (**Figure 1c**).**[4]** The concepts developed in this work thus provide an important ingredient for the quantum design of future carbon nanocircuitry. In addition, our latest results demonstrating an external control of these characteristics will also be presented.

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FIGURES

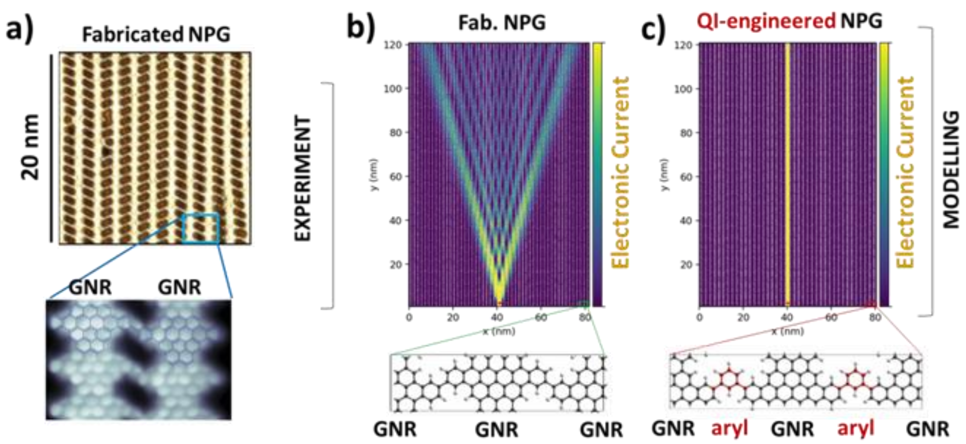

Figure 1: (a) Scanning tunneling microscopy image of the fabricated NPG. Inset: high-resolution image of the 2D material; **(b)** Electrical injection simulation in a large-scale model of the fabricated NPG and **(c)** in our proposed QI-engineered NPG.