Imprinting chirality and doping in graphene nanopores

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ABSTRACT

Functionalizing and imprinting chirality on 2D nanoporous membranes are key factors to drive specific host-guest interactions for selective sensing and sieving. Although a variety of pore structures can be obtained with Van der Waals supramolecular networks [1], stable membranes require stronger, covalent networks. Recent advances in this direction, such as the on-surface synthesis of nanoporous graphene (NPG) [2,3], demonstrate the feasibility of tailoring nanopores with the same atomic precision covalent 2D membranes.

Here we use pyrimidine functionalized bisanthracene precursors that undergo each of the reaction steps required for the realization of doped, chiral nanopores in the same graphene matrix. We have tracked each reaction step with STM demonstrating that chirality is imprinted from precursors to each of the intermediate products, up to the formation of pores in coupled graphene nanoribbons. Our combined tunnelling spectroscopy and ab-initio study indicates that the role of the N-dopants is to shift the conduction and valence bands rigidly without modifying the band gap, an effect that is hindered by the Fermi level pinning on the metal support [4], and to introduce localized states that can act as specific anchoring centres for chiral host-guest interactions. Our results pave the way to find out feasible on-surface routes to synthesise functionalized and chiral NPGs with longer range order.

REFERENCES

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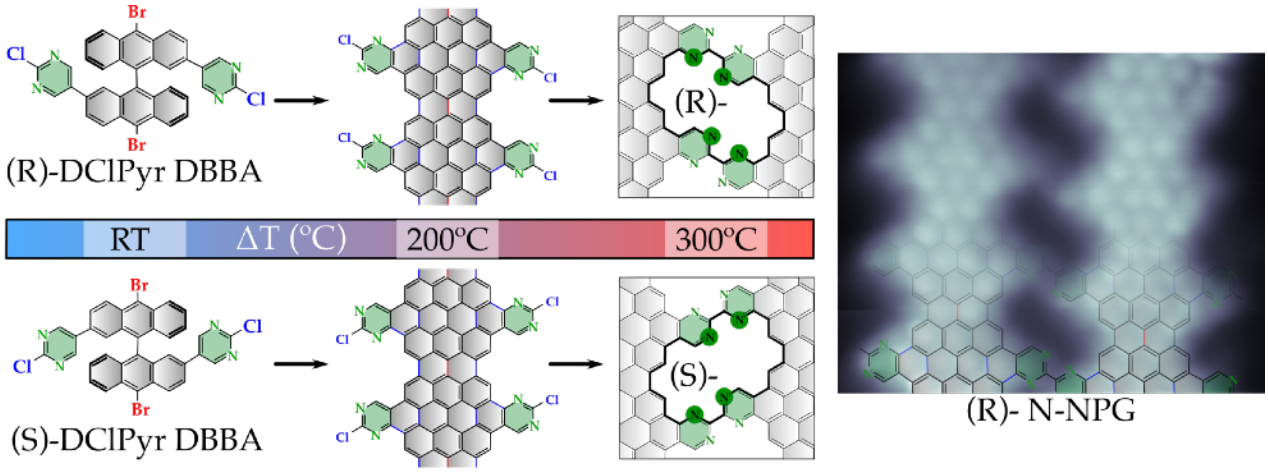

Figure 1: Schematic representation of the chemical path to synthesize nitrogen-doped NPG with axial chirality, and STM topography image of one of the two enantiomers that coexist on the surface. The image is obtained at constant height, with a CO-functionalized tip.