Built-in atomically sharp superlattice heterojunctions from hybrid Nanoporous Graphene

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Bottom-up synthesis has shown to be a very efficient method to build graphene nanoarchitectures with atomic precision. The most illustrative example is the plethora of graphene nanoribbons (GNR) that have been created practically à la carte. Despite such impressive advances in 1D homostructures, going beyond in structural complexity has turned to be a tough challenge. In particular, the synthesis of heterostructures has been limited to 1D, with no control on size and distribution of fusing components [1].
Here we report a hierarchical on-surface synthesis method for the fabrication of graphene-based superlattice heterojunctions by laterally coupling alternating doped/undoped graphene nanoribbons. For that we harness our ability to create parallely-aligned graphene nanoribbons superlattices [2] in order to guide the synthesis of a second GNR component, in this case an N-doped isostructural counterpart, within the empty channels of the superlattice. The final step consists on fusing the hybrid GNR array into a hybrid nanoporous graphene (h-NPG) [3]. Interestingly, the electronic structure of the final product preserves the one dimensional character of the individual components, with a rigid downshift of 0.2 eV for the N-doped GNR. The resulting structure can therefore be considered as a type II superlattice heterojunction.
Our hierarchical strategy fuses the concepts of 2D nanoporous graphene nanostructures, heteroatom doping and hybrid arrays in a single, novel graphene-related material, which we expect to seed new initiatives to synthetize other complex graphene nanoarchitectures with atomic precision.

REFERENCES

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FIGURES

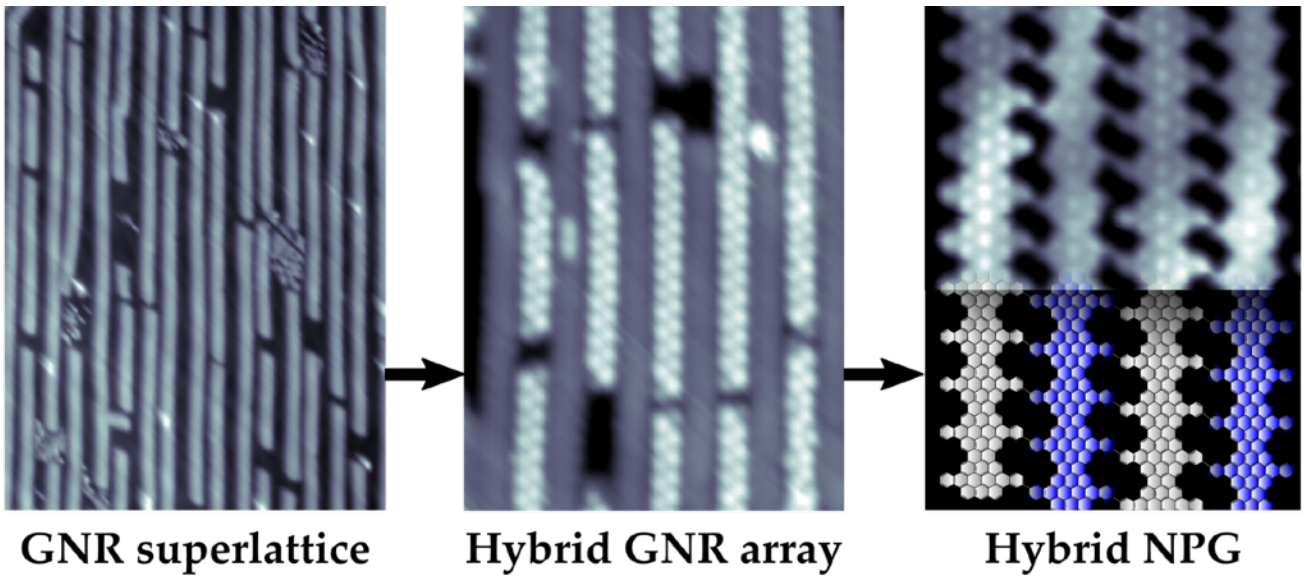

Figure 1: STM images of the on-surface synthesis of graphene superlattice heterojunctions