# Nitrogen-doping of atomically precise 1D and 2D graphene nanostructures

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The bottom-up synthesis of graphene nanoribbons (GNRs) is a well-stablished strategy to open the band gap of graphene and further modify its electronic properties. This can be done by tuning the ribbon width and edge structure, but also by introducing chemical dopants. Indeed, this synthetic approach allows atomic control of the intrinsic doping within the structure, enabling a fine control not only on the electronic but also on the chemical properties, and making this graphene nanostructure relevant also for catalysis and sensing.

Recently, an extension of this bottom-up strategy as led to the creation of a nanoporous graphene (NPG) structure that consist of coupled arrays of GNRs [1-3]. It offers practical advantages for the fabrication of GNR-based devices [1], but more importantly, the porous structure makes this material extremely attractive for molecular sieving and sensing. An important question that will determine the relevance of this nanomaterial in such applications is the capability to control their doping and functionalization in the same way as for GNRs.

Here we present a systematic study of the reaction pathways to synthesise 7-13 armchair GNRs doped with Nitrogen atoms at their outer phenyl rings, and the demonstration of the interribon dehydrogenative coupling necessary for the synthesis of N-doped NPG. The on-surface reaction on Au(111) surface has been tracked with STM complemented with XPS, and the electronic properties characterised by STS and DFT calculations. Both systems show similar band gap as compared to their undoped counterparts, but functionalized edges exhibit additional localised electronic states that can be relevant for sensing and filtering.

## References

1. C.Moreno et al., Science. 360 (2018), 199-203
2. C.Moreno et al., Chem. Mat. 31 (2) (2019), 331-341
3. C.Moreno et al., Chem. Comm. 54 (2018), 9402-9405

## Figures

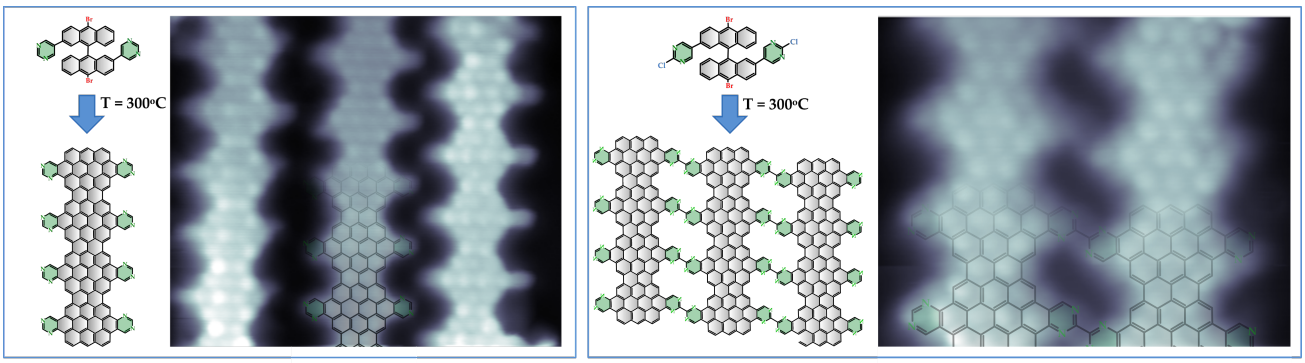


**Figure 1:** schematic representation of GNR and NPG and their STM topographic images at constant height, with a CO functionalized tip.