Fabricating carbon-based nanoarchitectures with atomic precision

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Unlike for inorganic materials, organic synthesis enables the fabrication of atomically precise nanoarchitectures with high structural and compositional versatility. The key for that is the capability to design molecular precursors basically “a la carte” and the ability to direct the reaction paths towards programmed final products. In the simplest version, the molecular precursors can be thought as LEGO building blocks with specific shape (structure), texture (composition), and coupling units (chemical interactions).

If one aims at fabricating two or lower dimensional nanoarchitectures, on-surface synthesis provides the right scenario to guide reactions: a surface that confines precursors in the 2D plane and catalyzes reactions. We exploit this synthetic strategy to fabricate different type of carbon-based 1D and 2D nanoarchitectures, and we characterize the structural and electronic properties with atomic precision by using scanning probe micro/spectroscopy. In this talk I will present different examples of the use of this method to fabricate 1 nm wide 1D graphene nanoribbons with functionalized edges (1, 2), 2D nanoporous graphene (3), and hybrid structures that combine units of different composition. I will also discuss different quantum phenomena that emerge in these nanoarchitectures.

REFERENCES

[1]. M. Panighel et al., Stabilizing Edge Fluorination in Graphene Nanoribbons. ACS Nano. 14, 11120–11129 (2020).
[2]. J. Li et al., Band Depopulation of Graphene Nanoribbons Induced by Chemical Gating with Amino Groups. ACS Nano. 14, 1895–1901 (2020).
[3]. C. Moreno et al., Bottom-up synthesis of multifunctional nanoporous graphene. Science 360, 199–203 (2018).

FIGURES

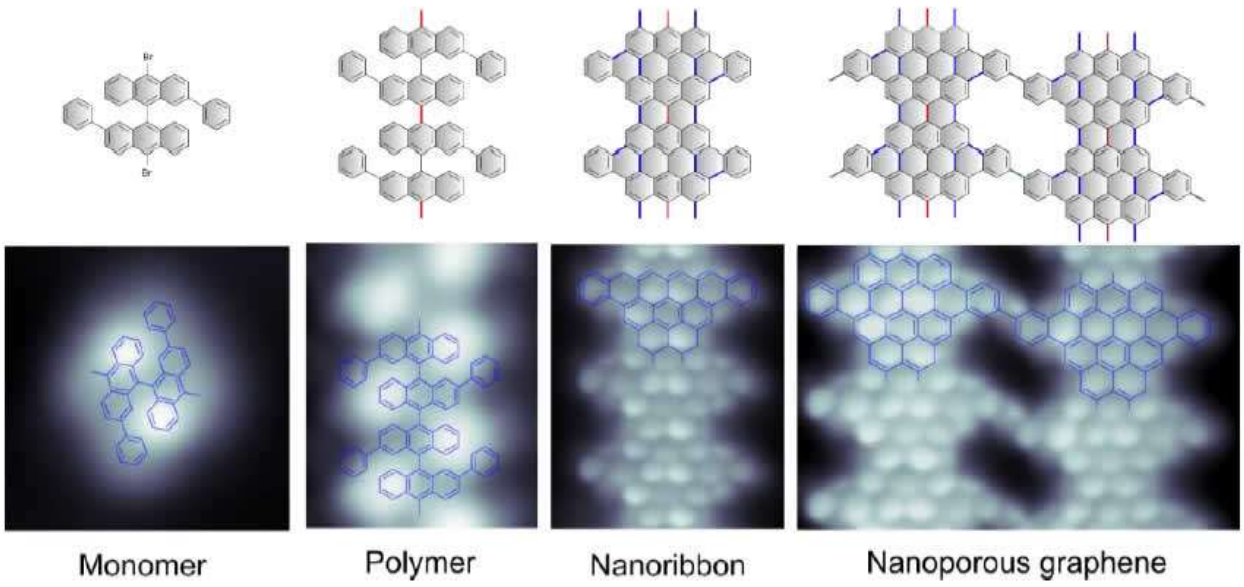

Figure 1: Reaction steps of the on-surface synthesis of nanoporous graphene.