Atomically Precise Synthesis of Graphenes: A Bottom-up Approach

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Abstract

Graphene, a two-dimensional carbon allotrope, has demonstrated exceptional physical properties such as ultrahigh charge carrier mobility, quantum Hall effect, and good optical transparency, which make it a realistic candidate for a number of electronic applications. The future research and application of graphene urgently calls for efficient synthesis at different size and length scales with high chemical definition.
Top-down production of graphene relies on peeling-off graphene layers from graphite in solution or on substrate. The high-quality graphene sheets can be also prepared by chemical vapor deposition. To open up the band gap of graphenes, a lateral confinement must be introduced, such as to cut graphene sheet into thin strips or unzipping carbon nanotubes into nanoribbons. In this presentation, we will demonstrate a bottom-up synthetic route to nanographenes and graphene nanoribbons, which provides an atomic precise synthesis of graphenes with robust nanostructures. This synthetic strategy is based upon the cyclodehydrogenation ("graphitization") of well-defined dendritic (3D) polyphenylene precursors with different topologies. The advantage of this approach is obvious as the size, shape and edge control, structural perfection and processability (solution, melt, even gas phase) of graphenes can be attained. Wide applications in electronic devices are possible with using nanographenes and graphene nanoribbons when they are rationally processed on the surfaces.

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