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On-surface synthesis of low-dimensional carbon nanostructures

Monday, July 14th, 2025, 9:15 AM

Room A - Nasini

Department of Chemical Sciences, via Marzolo 1, I-35131 Padova

On-surface synthesis is an emerging and powerful method in nanoscience and materials chemistry that enables the bottom-up fabrication of complex molecular structures directly on metal surfaces. This technique allows us to create low-dimensional carbon nanostructures such as graphene nanosheets, nanoribbons, and other atomically precise architectures with tailored properties. By utilizing surface-regulation strategies, scanning probe microscopy and high-resolution synchrotron radiation photoemission spectroscopy (SRPES) for in-situ characterization, on-surface synthesis offers unprecedented control over molecular geometry, bonding configurations, and electronic properties.



In this presentation, I will introduce a few examples from our recent studies of organic coupling reactions on surfaces, including the Ullman, Glaser and Sonagashira couplings. These examples include the selective synthesis of graphene nanosheets [1-2], nanowires [3], and nanoribbons with different topological structures [4-5]. By employing the thermodynamic and kinetic control strategies, we are able to tune the surface reactions toward the designed pathways to some extent. This is benefited from the fundamental understanding of the reaction mechanisms at the atomic level.

In the last part of my presentation, I will briefly introduce the Hefei Light Source which locates in our laboratory and Hefei Advanced Light Facility which is under construction now by our laboratory. If there is still time left, I will briefly talk about how to write a beamtime application proposal for using synchrotron radiation X-ray techniques.

For selected references, see:

- [1] L. Feng, et al. J. F. Zhu*, "On-surface synthesis of planar acenes via regioselective aryl-aryl coupling", Chem. Comm. 2020, 56, 4890.
- [2] Z. Zeng, et al. J. F. Zhu*, "Chemisorption-Induced Formation of Biphenylene Dimer on Ag(111)", J. Am. Chem. Soc. 2022, 144, 723.
- [3] T. Wang et al. J. F. Zhu*, "Kinetic Strategies for the Formation of Graphyne Nanowires via Sonogashira Coupling on Ag(111)", J. Am. Chem. Soc. 2018, 140, 13421.
- [4] T. Qin et al. J. F. Zhu*, "Synthesis of a Porous [14]Annulene Graphene Nanoribbon and a Porous [30]Annulene Graphene Nanosheet on Metal Surfaces", Angew. Chem. Int. Ed. 2023, 135, e202306368.
- [5] T. Qin et al. J. F. Zhu*, "Synthesis of Graphene Nanosheets Containing Ultra-Narrow Nonplanar Nanopores on Surfaces", Angew. Chem. Int. Ed. 2025, 202504734.

Your presence will be very much appreciated.

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