On-surface synthesis of graphene nanoribbons: From molecules to devices

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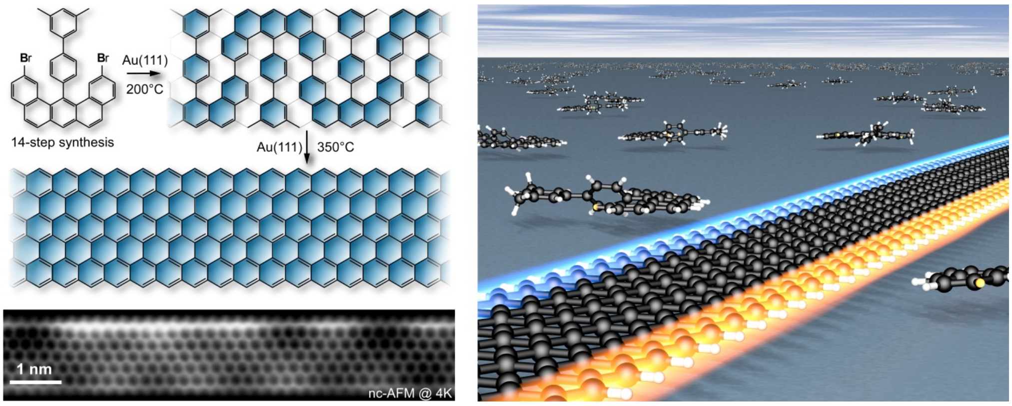
Graphene nanoribbons (GNRs) are promising candidates to overcome the low on/off-behaviour of graphene - a zero band gap semiconductor - while still preserving high charge carrier mobility that is essential for the fabrication of efficient field effect transistors. It has been shown that atomically precise GNRs can be fabricated by an on-surface synthesis approach [1]. This versatile method has been successfully applied to the fabrication of armchair GNRs (AGNRs) of different widths - and thus different band gaps - as well as more complicated structures like chevron GNRs or heterojunctions [2]. More recently, it has also been extended to afford the fabrication of GNRs with zigzag edges (ZGNRs) [3], which are predicted to exhibit spin-polarized edge states.

In a first part of this presentation, I will briefly review the on-surface synthesis approach to AGNRs, and discuss some recent additions to the family of GNRs such as atomically precise 6-ZGNRs [3], GNRs with chiral or cove edges, as well as GNR heterostructures incorporating tunable quantum dots [4]. In a second part, I will address some of the challenges related to the technological application of GNRs, in particular regarding GNR fabrication scalability and device fabrication. Recent results on GNR field effect transistors with high performance will be presented [5]. Finally, I will discuss a family of zigzag edge-extended AGNRs hosting topological electronic phases. It will be shown that variations of the AGNR backbone width and the zigzag edge segment spacing drive this family of GNR structures into trivial, metallic and topological insulating phases [6].



Synthesis of atomically precise ZGNRs using a bottom-up strategy based on surface-assisted arrangement and reaction of precursor monomers. ZGNR are predicted to host spin-polarized electronic edge states that make them interesting for spintronic applications.

[1] J. Cai *et al*., *Nature* **466**, 470 (2010)
[2] L. Talirz *et al*., *Adv. Mater*. **28**, 6222 (2016)
[3] P. Ruffieux *et al*., *Nature* **531**, 489 (2016)
[4] S. Wang *et al*., *Nano Lett*. **17**, 4277 (2017)
[5] J.P. Linas *et al*., *Nature Commun*. **8**, 633 (2017)
[6] O. Gröning *et al*., *submitted* (2018)