On-surface synthesis and characterization of a new low-bandgap graphene nanoribbon

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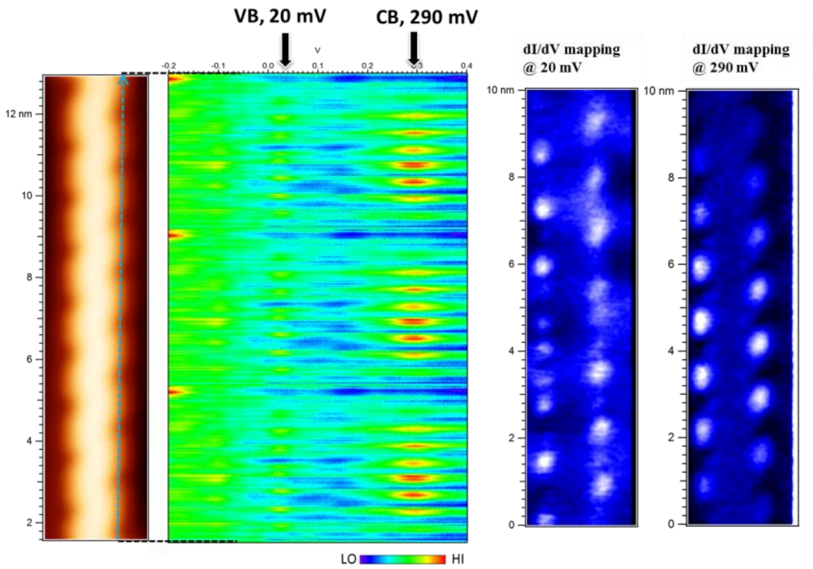
Graphene nanoribbons (GNRs) are a promising class of materials for future electronic applications. Precise control of edge structure and width allows to induce a widely tunable band gap in GNRs, and thus to overcome one of the main limitations of graphene for electronic switching applications. Building on a bottom-up method, GNRs with armchair as well as zigzag edges have successfully been synthesized and characterized.[1,2] Recently, GNR field-effect transistors have been fabricated and show promising on-current and switching behavior.[3] However, for further improved device performance, high quality GNRs with low-bandgap are urgently needed.

Here we report the synthesis of a new low-bandgap graphene nanoribbon on Au(111) through surface-assisted aryl−aryl coupling and subsequent cyclodehydrogenation of a properly chosen molecular precursor. The structure of this ribbon was characterized by high-resolution non-contact AFM and STM. Using scanning tunneling spectroscopy we find that this particular GNR exhibits a strongly length-dependent electronic band gap, which converges to less than 0.3 eV for ribbons approaching 10 nm in length. These experimental results are backed up by density functional theory as well as by tight binding calculations, which reveal further interesting details concerning the topological properties of this novel graphene nanoribbon.[4]



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