Spring 15

Colloquium Cukrovarnická

Ve čtvrtek dne 9. dubna 2015 v 15:00 hod.
ve Fyzikálním ústavu Cukrovarnická v seminární místnosti
(budova A, 1. patro)

Electronic and optical properties of atomically precise graphene nanoribbons

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Among graphene related materials, nanoribbons (GNRs) – narrow stripes of graphene – have emerged as promising building blocks for nanoelectronic devices. The lateral confinement in GNRs opens a bandgap that sensitively depends on the ribbon width, allowing in principle for the design of GNR-based structures with tunable properties. However, structuring with atomic precision is required to avoid detrimental effects induced by edge defects.

Recently, we have introduced a versatile route for the bottom-up fabrication of GNRs [1], allowing for the atomically precise synthesis of ribbons with different shapes as well as heterojunctions between doped and undoped ribbon segments [2,3]. In this presentation, I will report on detailed experimental and computational investigations of the structural, electronic and optical properties of selected GNRs and heterojunctions [2-6].

For the case of armchair GNRs of width N=7, the electronic band gap and band dispersion have been determined with high precision [4,5]. Optical characterization has revealed important excitonic effects [6], which are in good agreement with ab initio calculations including many-body effects. For the case of heterojunctions, consisting of seamlessly assembled segments of pristine (undoped) graphene nanoribbons and deterministically nitrogen-doped graphene nanoribbons, we find a behavior similar to traditional p–n junctions. With a band shift of 0.5 eV and an electric field of 2×10^8 V m^{-1} at the heterojunction, these materials bear a high potential for applications in photovoltaics and electronics.

[1] J. Cai, et. al *Nature* **466**, 470 (2010). [2] S. Blankenburg, et al. *ACS Nano* **6**, 2020 (2012). [3] J. Cai, et al. *Nature Nanotech.* **9**, 896 (2014). [4] P. Ruffieux, et al. *ACS Nano* **6**, 6930 (2012). [5] H. Soede, et al. *Phys. Rev. B* ***91,*** 045429 (2015). [6] R. Denk, et al. *Nat. Commun.* **5**, 4253 (2014).

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