Epitaxial Semiconductor – Superconductor Hybrid Materials for Topological Superconductivity

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Semiconductor-metal interfaces are key elements in nanostructured electronics and device architectures. This is in particular true in the field of low dimensional topological superconductivity, where semiconductor nanowires with high spin orbit coupling coupled to a superconducting phase constitute some of the most promising candidates in the search for materials suitable for quantum information technology[1]. I will discuss the synthesis, structural and compositional properties hybrid semiconductor-superconductor nanowire and hybrid materials grown in-situ by Molecular Beam Epitaxy[2]. Because these materials give a hard superconducting gap proximitized in the semiconductor, they serve as excellent platform for studying Andeev bounds states and Majorana bound states, which opens for new application possibilities in the field. I will present on the synthesis of various types of hybrid semi-super materials and discuss the challenges and material requirements needed for realizing and eventually manipulating topological protected quantum states.

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[1] Nayak et al. *Rev. Mod. Phys.* **80**, 1083 (2008)

[2] Krogstrup et al. *Nature Mater.* **14**, 400-406 (2015)