PHD GRANT

Semiconductor nanowires for Ultimate Magnetic Objects

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A quantum dot inserted in a nanowire allows a versatile design of its shape and strain configuration, in order to tailor the orbital and spin anisotropy of confined holes. As a result, the optical selection rules can be adapted to the optical manipulation of the confined hole contemplated as a qu-bit. In addition one can adjust the magnetic anisotropy of the so-called magnetic polaron formed when magnetic impurities are oriented around a hole.

The PhD work was focused on four main steps: (1) the formation of the gold nanoparticle which induces the growth of the ZnTe nanowire, (2) the incorporation of CdTe quantum dots, supported by a model of growth taking into account the volatile character of Cd and CdTe; (3) the formation of a (Zn,Mg)Te shell with clean interfaces and smooth sidewall surfaces; (4) the p-type doping of the shell and the electrical characterization of a single nanowire. Optimizing and combining these processes allows us to grow nanowires with inserted quantum dot of variable length (Fig. 1) and good optical properties.

The study of the emission diagram and the formation of the magnetic polaron with tailored magnetic anisotropy is now pursued in the frame of an ANR project.

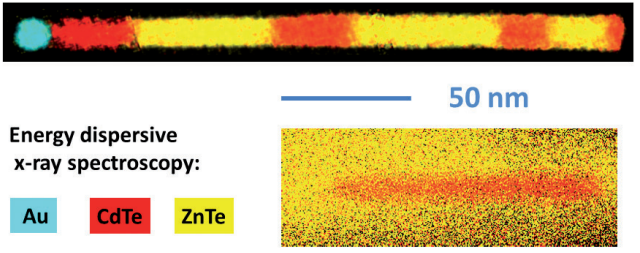

Fig.1: A ZnTe nanowire with CdTe insertions of various lengths (top) and a 80-nm long CdTe quantum dot in a ZnTe nanowire with its shell (bottom).

OUTCOMES

[1] Nanowire growth and sublimation: CdTe quantum dots in ZnTe nanowires, Phys. Rev. Materials 2, 043404 (2018)

[2] Control of the incubation time in the vapor-solid-solid growth of semiconductor nanowires, Appl. Phys. Lett. 110, 263107 (2017).

[3] Diffusion-driven growth of nanowires by low-temperature molecular beam epitaxy, J. Appl. Phys. 119, 164303 (2016).

Oral presentation: 19th. Int. Conf. MBE, Montpellier, 2016.

Leverage: ANR ESPADON, 2016.