# Semiconductor nanowires for Ultimate Magnetic Objects


## Principal investigators

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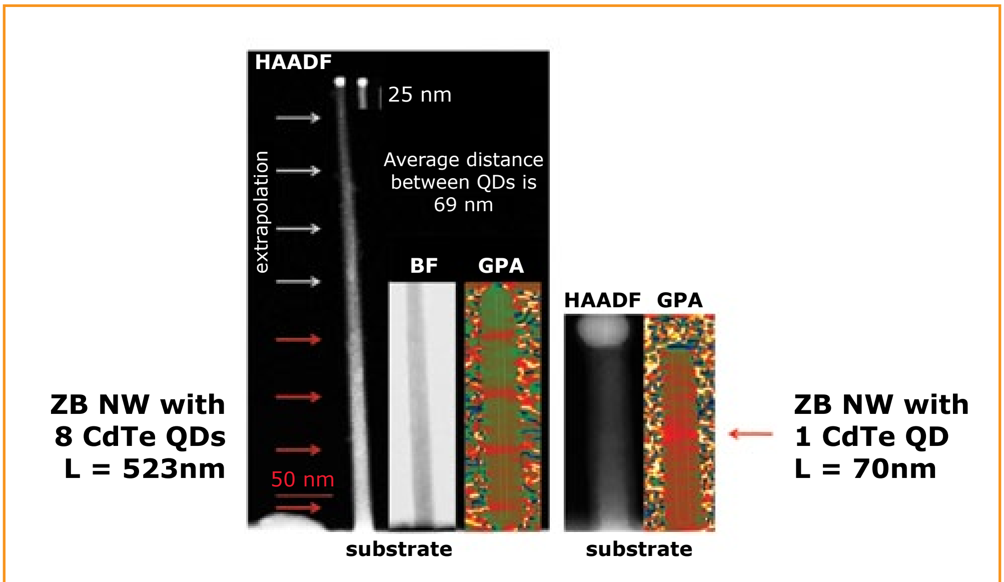
**The main objective is to combine electrical doping and magnetic doping in quantum dots inserted in nanowires made of II-VI semiconductors. Inorder to achieve this goal, (1) we fabricate nanometer-sized magnetic objects where the ferromagnetic interaction induced by one or a few carriers in an ensemble of magnetic impurities is optimized by confinement and strain engineering – and (2) we apply to these objects magneto-optical spectroscopy, magneto-transport, and electrical biasing.**

## Description

Making semiconductors ferromagnetic appears as the best way towards all-semiconductor spintronics. This can be achieved with diluted magnetic semiconductor, i.e., a semiconductor as close as possible to those that are widely used in nanoelectronics, in which a magnetic impurity is introduced. The usual properties of the semiconductor are preserved (such as electrical doping, electrical transport, optical properties, and the possibility to fabricate heterostructures and nanostructures combining several semiconductors). The most studied diluted magnetic semiconductor is (Ga,Mn)As, where Mn randomly substitutes for Ga. As (Ga,Mn)As is ferromagnetic and can be inserted into semiconductor devices, several functions of spintronics have been realized already, although the critical temperatures are too low for applications.

In spite of an even lower critical temperature, II-VI structures offer a greater flexibility to study different mechanisms exploiting wavefunction engineering and strain engineering. Our program is based on ZnTe nanowires embedding diluted magnetic semiconductors, e.g. in the form of a (Cd,Mn)Te quantum dot.

Our goal is to (1) fabricate II-VI nanowires incorporating a diluted magnetic semiconductor, such as a (Cd,Mn)Te quantum dot embedded in a ZnTe nanowire, with a (Zn,Mg)Te shell to adjust the strain in the quantum dot; (2) achieve the p-type doping of selected parts of this structure, as well as Schottky and ohmic contacts and FET structures; (3) perform a magneto-optical study of the magnetic polaron in such a quantum dot, with different charge configurations; (4) perform preliminary studies of the transport properties of these nanowires.




*Transmission electron microscopy images of two nanowires from the same sample, where ten CdTe quantum dots (QD) have been inserted in order to monitor the growth: 8 CdTe markers are visible on the long nanowire (left), against only 1 on the short nanowire (right) which hence started to grow later. BF=bright field, HAADF = high-angle annular dark field, GPA= geometric phase analysis are three different techniques of transmission electron microscopy.*

**Posters:** "Strain in core-shell nanowires and dots in nanowires", A. Artioli, P. Rueda-Fonseca, M. Orrù, Y. Genuist, R. André, F. Donatini, J.-F. Motte, G. Nogues, E. Robin, M. Lopez-Haro, S. Tatarenko, E. Bellet-Amalric, D. Ferrand, and J. Cibert, EuroMBE 2015 European workshop on Molecular Beam Epitaxy – Canazei (Italy) – March 16-19 2015.

"Wurtzite/Zinc-Blende Polymorphism in ZnTe Nanowires", P. Rueda-Fonseca, A. Artioli, M. Orrù, M. Den Hertog, Y. Genuist, R. André, D. Ferrand, J. Cibert, S. Tatarenko and E. Bellet-Amalric, EuroMBE 2015 European workshop on Molecular Beam Epitaxy – Canazei (Italy) – March 16-19 2015.

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