Growth of III-V nanowires: from fundamental physics to device applications

L.Sorba, A. Li, E. Husanu, D. Ercolani, S. Roddaro, L. Romeo, F. Rossella, F. Giazotto, A. Tredicucci, M. S. Vitiello, A. Pitanti, L. Viti, and F. Beltram
NEST, Istituto Nanoscienze-CNR and Scuola Normale Superiore, Piazza S. Silvestro 12, I-56127 Pisa, Italy

lucia.sorba@nano.cnr.it

The catalyst-assisted growth of semiconductor nanowires (NWs) has emerged as a flexible and promising technology for the synthesis of self-assembled nanostructures with potential impact on the investigation of fundamental properties and on the development of innovative devices. Different materials can be easily combined in individual high-quality single crystal nanowires without lattice-matching constrains. Axial and radial heterostructured nanowires have been realized combining semiconductor materials with suitable physical properties. As a consequence, nanowire technology represents a powerful research and development platform for fundamental physics investigations as well as for innovative device applications in nanoelectronics [1], optoelectronics [2] and energy harvesting [3]. In the first part of my presentation I will show examples for the realization of axial and radial heterostructured nanowires with controlled morphology and crystal structure (see Fig.1). Furthermore, I will show that InAs/InP NW-based single-electron devices have a great potential and allow an extreme and reliable control of electron filling down to the last free electron, even if energy spectrum and coupling are usually harder to tune [4-5]. In the third part of the presentation I will show the use of nanowire technology in the development of thermoelectric (TE) devices. I will show recent results on thermovoltages in single InAs nanowire (NW) field effect transistors [3].

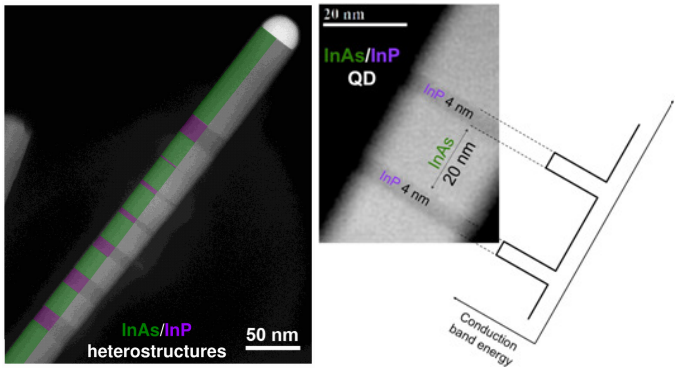

Fig.1 STEM and TEM micrographs of InAs/InP NW heterostructures

References:

[1] Y. Li, F. Qian, J. Xiang and C.M. Lieber, *Materials Today* **9**, 18 (2006).
[2] M.S. Vitiello, D. Coquillat, L. Viti, D. Ercolani. F. Teppe. A. Pitanti, F. Beltram, L. Sorba, W. Knap, A.Tredicucci, *Nano Lett*. **12**, 96 (2012).
[3] S. Roddaro, D. Ercolani, M. A. Safeen, S. Suomalainen, F. Rossella, F. Giazotto, L. Sorba, and F. Beltram, *Nanoletters* in press.
[4] S. Roddaro, A. Pescalini, D .Ercolani, L. Sorba, F. Beltram, *Nano Lett*. **11**, 1695-1699 (2011).

[5] L. Romeo, S. Roddaro, A. Pitanti, D. Ercolani, L. Sorba, F. Beltram, *Nano Lett*. **12**, 4490 (2012).