

Semiconductor Nanowires

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In my seminar I will first give a broad introduction into the physics of semiconducting nanowires, what they are, how we can make them, and for what we use them. I will provide details on the nanowire growth activities in the NEST lab in Pisa, led by my colleague Prof. Lucia Sorba, and on the transport measurements on semiconductor nanowires performed by my colleague Dr. Stefano Roddaro.

I will then report on the Pd-assisted chemical beam epitaxy growth of zinc blende InAs nanowires which are grown on InAs(111)A substrates by employing Pd octane- and hexadecyl-thiolates as catalyst precursors. These results were obtained in collaboration between the NEST lab in Pisa and Prof. G. U. Kulkarni's group at JNCASR in Bangalore. The structural properties of these nanowires were investigated by scanning and transmission electron microscopy. Furthermore, we demonstrate the growth of InAs nanowires on patterned substrates by employing the Pd hexadecylthiolate precursors as a direct-write resist in electron beam lithography [1].

During the growth of InAs nanowires from Pd catalyst particles on InAs(111)A, two distinct classes of nanowires are observed with smooth or zigzagged sidewalls. We show that this is related to a bimodal distribution of the wire-tip diameter: above a critical diameter wires grow with smooth sidewalls, and below with zigzagged morphology. Transmission electron microscopy analysis shows that the catalyst particles at the tip of zigzagged wires are smooth and have a higher aspect ratio than those at the tip of smooth wires. Zigzagged wires grow from liquid particles in the vapor–liquid–solid (VLS) mode whereas the smooth ones grow from solid particles in the vapor–solid–solid (VSS) mode [2].

References:

- [1] S. Heun, B. Radha, D. Ercolani, G. U. Kulkarni, F. Rossi, V. Grillo, G. Salviati, F. Beltram, and L. Sorba: *Pd-Assisted Growth of InAs Nanowires*, *Crystal Growth & Design* **10** (2010) 4197.
- [2] Stefan Heun, Boya Radha, Daniele Ercolani, Giridhar U. Kulkarni, Francesca Rossi, Vincenzo Grillo, Giancarlo Salviati, Fabio Beltram, and Lucia Sorba: *Coexistence of Vapor–Liquid–Solid and Vapor–Solid–Solid Growth Modes in Pd-Assisted InAs Nanowires*, *Small* **6** (2010) 1935.