SYNW 2 Symposium: Nano-Wires II

Time: Wednesday 16:00–17:30 Room: HSZ 04

Invited Talk SYNW 2.1 Wed 16:00 HSZ 04

Quantum devices based on heterostructure semiconductor nanowires — •Claes Thelander — Solid State Physics, Lund University, 221 00 Lund, Sweden

Epitaxial growth of heterostructure InAs/InP semiconductor nanowires will be described. Fabrication of Ohmic contacts to such nanowires allows investigation of their transport characteristics. We observe that thin InAs nanowires experience strong radial quantum confinement and are depleted of charge carriers, whereas thicker wires are almost metal-like. A few quantum-based devices realized in the InAs/InP heterostructure system will be presented. Growth of a short (10 nm) InAs dot section between two InP tunnel barriers results in very strong quantum confinement along the axial direction. Filling such a dot with ˜20 electrons only involves the ground state in the axial direction, and clear shell filling effects are observed due to spin and orbital degeneracies in the radial directions. We also investigate electron transport in multiple tunnel junction devices. It is demonstrated that electrons can be stored in meta-stable states in a tunnel junction-based nanowire memory containing up to 10 InP barriers. Memories based on electron tunneling are predicted to have considerable faster write speeds than corresponding devices relying on thermionic emission over a barrier.

Invited Talk SYNW 2.2 Wed 16:30 HSZ 04

ZnO nanowires and naowire arrays: controlled growth and microscopic characterizations — •Hongjin Fan — Max Planck Institute of Microstructure Physics, 06120 Halle, Germany

Semiconductor nanowires (NW) are promising building blocks for nanoscale electronic and optical devices. For this, controlled synthesis and microscopic characterization of the physical properties of the NW are in the center of current research. In this talk the growth of ZnO NW and NW arrays will be presented. The successful fabrication of periodically arranged ZnO NW is achieved by combining substrate patterning and the catalyst-directed vapor-liquid-solid growth. Various kinds of templating methods have been used including metal nanotube membranes and self-assembled nanosphere mask. We demonstrate the control of position, diameter, length, and orientations of the NW.

The single-crystallinity and epitaxial growth of ZnO NW arrays are verified by cross sectional TEM analysis. Microscopic characterization of individual NW are undertaken using micro-PL spectroscopy to assess the optical quality and study stimulated emissions, scanning cathodoluminescence to identify spatial origin of luminescence and bending effect, and pieozoresponse force microscopy to measure the effective piezoelectric coefficient. In addition, we will show the in-situ manipulation of the NW using SEM-based nanotips.

Invited Talk SYNW 2.3 Wed 17:00 HSZ 04

Electrically-Driven Nanowire Devices for Sensors and Photonics — •Oliver Hayden — Department of Chemistry and Chemical Biology, Harvard University, Cambridge, MA 02138, USA, current address: IBM Research GmbH, Zurich Research Laboratory, CH-8803 Rueschlikon, Switzerland

Semiconducting nanowires are one of the most promising low dimensional materials for the bottom-up fabrication of nanodevices. The application of photonic and electrical devices from silicon and cadmium sulphide nanowires is presented. Ion-sensitive field effect transistors are formed with silicon nanowires and nanotubes, which allow label-free observation of immunological reactions with single virus sensitivity. Nanoscale light emitting diodes are integrated in microfluidic channels and used as intrinsically confocal light sources. These LEDs were applied to demonstrate single analyte detection and cellular imaging. The additional integration of nanowire avalanche photodiode detectors allows even optoelectronic coupling on the nanoscale.