Rainer Timm, J Nanomater Mol Nanotechnol 2017, 6:4 (Suppl)
DOI: 10.4172/2324-8777-C1-008

16th World Nano Conference

June 05-06, 2017 Milan, Italy

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Atomic-scale characterization of semiconductor nanowire surfaces during device operation

Semiconductor nanowires are promising candidates for next generation electronic and optoelectronic devices and they are a great playground for materials science, because they give a large flexibility in combining different materials. As an example, III-V semiconductor nanowires can be epitaxial grown on silicon without interfacial defects, allowing to utilize the enhanced charge carrier mobility of III-V materials with low-cost, industrially compatible substrates. Due to the small size and high aspect ratio of nanowires, their properties are to a significant extend determined by surface effects. Atomic-scale surface and interface characterization is therefore crucial for understanding and improving the performance of nanowire-based devices. In this talk, author will present different approaches based on scanning tunneling microscopy and X-ray photoemission spectroscopy for correlating atomic-scale surface structure, chemical composition, and electronic properties of III-V semiconductor-based nanowire hetero¬structures and devices. We map those properties across interfaces between different crystal phases, different doping levels, or different semiconductor materials. Author will focus on atomically resolved scanning tunneling microscopy (STM) results of various GaAs, InAs, InP and InSb nanowire surfaces. By combining STM imaging with scanning tunneling spectroscopy (STS) measurements, we simultaneously study the surface structure and local electronic properties across the interfaces of axial nanowire heterostructures. Our most recent efforts include in-operando and *in-situ* studies, where we investigate nanowires during device performance or while their surface becomes modified.

Biography

Rainer Timm completed his Doctor of Science at Technische Universität Berlin, Germany, in 2007. After that, he moved to Lund University, Sweden, where he became an Associate Professor of Physics in 2015. He is Vice Head of the Division of Synchrotron Radiation Research, Coordinator of Master's program in Physics - Materials Science, and member of NanoLund Center for Nanoscience at Lund University. His research focuses on "The characterization of semiconductor nanostructures using scanning probe microscopy and synchrotron-based methods, especially on the correlation of atomic-scale crystal structure, surface electronic properties, and device performance".

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