

Wonderful Properties of Compound Semiconductor Nanowires and their Arrays

Harri Lipsanen

Department of Electronics and Nanoengineering, Aalto University
Tietotie 3, 02150 Espoo, Finland
Harri.lipsanen@aalto.fi

Among the many families of nanostructures semiconductor nanowires have been shown to exhibit interesting properties for both scientific research and applications. The ability to create nanostructures and their assemblies with chosen atomic scale composition and structure on many length scales opens fascinating possibilities. The synthesis of semiconductor nanowires based on III-V compound semiconductors has progressed a great deal in recent years, and new device concepts have been proposed. In optical applications tailored nanowire arrays add another degree of freedom for tailoring the light-material interaction.

One of the critical issues concerning future applications is the cost of manufacturing. We have demonstrated synthesis of high-quality GaAs nanowires on very low-cost substrates such as regular window glass. In addition, the processing of catalytic gold nanoparticles for nanowire arrays was demonstrated without expensive nanolithography steps. The properties of nanowires are often governed by their extra-large surface to volume ratio. Due to detrimental effects such as surface recombination, passivation layers are frequently needed. Our studies present several effective passivation methods based on epitaxial layers and on layers fabricated by atomic layer deposition.

The presentation shows how the nanowires and their arrays are used to study fundamental properties such as phonon confinement and mechanical properties. The demonstrated nanowire applications include second-harmonic generation, THz generation, LEDs, photodetectors and all-optical logic gates.