ATOMIC SCALE CHARACTERIZATION OF III-V SEMICONDUCTOR NANOSTRUCTURES

KOMNINOU Philomela

Aristotle University of Thessaloniki, Thessaloniki, Greece, EU

Abstract

One, two and three-dimensional (nanowires, quantum wells, quantum dots) nanostructures are the building blocks of emerging novel photonic and electronic device applications. This technology, although one of the most "environment-friendly" available in the market is still far from being mature and hence devices are far from their intrinsic limits. Much more research efforts are needed to address materials properties and standardization of their structures. State-of-the-art transmission electron microscopy (TEM) along with the associated spectroscopies comprise the key techniques for the structural characterisation of heterostructured systems down to the nanoscopic and atomic scales and it should be interactively combined with computational design and modeling of dimensions, structures, defects and compositions.

Materials issues encountered by TEM involve: a) A nano- and atomic-scale investigation of interfacial and defect structures. b) Understanding of defect introduction mechanisms and related phenomena. c) Local strain fields and chemistry d) Electronic structure of structures defects and interfaces.

In this presentation, examples will be discussed in which an hierarchical integrated multiscale framework is employed comprising high resolution TEM (HRTEM), quantitative HRTEM (qHRTEM), high-angle-annular-dark-field (HAADF) or Z-contrast imaging in Scanning TEM (STEM) and analytical methods provided such as energy dispersive X-ray spectroscopy (EDXS) combined with computational modeling. Results of empirical interatomic potential simulations and density functional theory (DFT) calculations will illustrate modeling of the energetically favorable defect/interface structures and electronic properties. Simulations using the resulting models for correlation with the corresponding experimental HRTEM images will be also presented.

Keywords: TEM, HRTEM, heterostructured nanostructures, III-V Semiconductors, structural defects, interfaces

Author did not supply full text of the paper.