ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΡΗΤΗΣ

ΤΜΗΜΑ ΦΥΣΙΚΗΣ

ΓΕΝΙΚΟ ΣΕΜΙΝΑΡΙΟ ΤΜΗΜΑΤΟΣ ΦΥΣΙΚΗΣ

PHYSICS COLLOQUIUM

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17:00-18:00

3rd Floor Seminar Room

"Interface science and engineering in compound semiconductor physics and technology: Towards high efficiency devices"

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Abstract

The advent of interface science and engineering started about three decades ago with pioneering works on the structure of interfaces that exhibit layer periodicity. The field has grown to become multidisciplinary, combining theoretical modelling with experimental atomic-scale structural and chemical analysis performed principally by transmission electron microscopy (TEM) methods. This has translated into important benefits concerning the understanding of interfaces in metals and ceramics, and controlling their influence on material behaviour. Multiple applications have been demonstrated in both polycrystalline materials as well as bicrystal composites that comprise well-defined interfaces. Especially regarding semiconductor technology, the controlled growth of structural interfaces is the cornerstone that enables the successful fabrication of devices. Given the complexity of compound semiconductors, the constant need for dimensional reduction, and the benefits offered by nano-scale heterostructures, this feat requires profound understanding of interfacial topology, energy, and admissible interfacial defects. Successful modelling is accomplished by the interactive integration of theory with TEM and high resolution TEM (HRTEM) observations of quantitative character. This approach will be demonstrated focusing on interfacial structure in III-Nitride compound semiconductors for optoelectronic device applications (e.g. LEDs, laser diodes, and sensors). In order to achieve high internal quantum efficiency of such devices, and to extend their operational wavelength ranges, it is required to diminish the polarization-induced spatial separation of electron-hole pairs which is greatly amplified by the strain field at pseudomorphic hetero-interfaces. For this purpose, instead of following the typical polar epitaxial growth, growths along non-polar and semi-polar orientations, as well as quantum dot nanostructures, are explored. However, foreign substrates induce large defect densities that cause nonradiative carrier recombinations and reduce device efficiency and lifetime. The role of the interfacial region is critical for controlling the defect and strain introduction mechanisms.

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