University of Crete
Department of Physics

Physics Colloquium

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New aspects in III-N alloys' epitaxy and applications

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ABSTRACT

III-nitride materials constitute a major semiconductor platform with a wide spectrum of applications. Today, they underpin solid state lighting technologies and are extensively used in power RF systems and in high efficiency power conversion devices. Their distinctive characteristics—wide bandgaps, high breakdown fields, strong polarization effects, and thermal stability—point toward a broad range of future applications, however several unresolved bottleneck issues that continue to limit full technological exploitation need to be addressed. InGaN alloys system is a prominent example: their direct bandgap spans the entire UV through NIR spectrum, providing a foundation for diverse optoelectronic device technologies, but their inherent thermodynamic propensity for phase separation, strongly complicated epitaxial growth, lattice mismatch and need for engineering of the piezoelectric polarization fields to suit devices operation are open challenges. Herein, the advances achieved in overcoming these challenges are described. Recent results in understanding epitaxial surface kinetic mechanisms and their effects in control of surface-driven alloy composition inhomogeneities are instrumental in achieving device grade epilayers in the entire ternary composition range and are expected to enable precise control in the development of relative heterostructures and nanostructures. Finally, concerning their AlGaN counterparts, we present investigations exploring their integration into quantum device technologies.