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Thursday May 21th, 2026 at 13h30
LMOPS, CentraleSupélec, 2 rue E. Belin, Metz
Salle du conseil

Gallium-nitride-based Ultraviolet Photodetectors

The demand for ultraviolet (UV) detectors in civil, military, space, and disinfection applications has spurred research into more efficient technologies. Silicon-based UV detectors dominate the market but suffer from low band gap and poor radiation resistance, limiting use in harsh environments. Wide band gap materials like gallium nitride (GaN) and aluminum gallium nitride (AlGaN) offer tunable band gaps (3.4–6.2 eV), thermal stability, and radiation hardness. However, GaN-based UV detectors targeting 200–365 nm still show low responsivity (e.g., ~0.05 A/W at 280 nm) due to poor crystalline quality and high dislocation density. Building on prior success with GaN-based blue LEDs, this research develops III-nitride UV detectors aiming for responsivity >0.05 A/W at 280 nm. Three subprojects were carried out: (1) bulk GaN metal-semiconductor-metal (MSM) UV photodetectors (PDs); (2) integration of silver nanoparticles (Ag NPs) with GaN MSM UV PDs; and (3) integration of aluminum nanoparticles (Al NPs) with GaN MSM UV PDs. In the first phase, bulk GaN MSM detectors were studied for their good crystalline quality. In the second subproject, Ag NPs were integrated to exploit surface plasmon resonance for enhanced light absorption and carrier collection, their synthesis via pulsed laser ablation in liquid was investigated in depth. The third subproject similarly used Al NPs, enabling comparative analysis of plasmonic enhancement across UV wavelengths. Performance metrics (responsivity, detectivity, sensitivity, and transient response) were evaluated for detectors with Ag NPs, Al NPs, and without nanoparticles. These findings clarify the role of plasmonic nanomaterials in improving GaN-based MSM UV photodetectors and serve as a benchmark for future device optimization.

Séminaire organisé dans le cadre du programme interdisciplinaire MAT-PULSE (*Materials and Physics @ Ultimate Scale: Nanotech for a sustainable digital world*)

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