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Unconventional semiconductors for advanced III-nitride photonics

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Gallium Nitride (GaN)-based compound semiconductors, throughout their entire composition (tuned by varying the Aluminum (Al), Gallium (Ga), and Indium (In) elemental content), possess direct bandgap and their bulk-layer-spectrum can be tuned from deep ultraviolet (~200 nm) to near-infrared (~1700 nm). Furthermore, subband-energy engineering of AlGaN/GaN superlattice quantum structures enable the spectral response be pushed up to terahertz (~300 μm). As such, GaN-based photonic technology can be used in everyday to biotech and scientific applications including solid state lighting; detection of bio-agents/drugs/explosives; and optogenetics. However, inherit polarization fields hinder the electron and hole recombination in the "quantum wells" of such photonic devices. This "polarization" effect is so pronounced in LEDs that reduced efficiencies under high injection currents – a phenomenon known as "droop"-is imminent in all devices. Hence, polarization-free approach is essential for droop-free photonics across the Ultraviolet-Visible-Terahertz spectrum. In this talk, we are going to discuss the opportunities in addressing issues in advanced III-nitride photonics through unconventional semiconductors.

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