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Gallium nitride compound semiconductors for ultraviolet, visible and Terahertz 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 enables the spectral response to push up to Terahertz (~300 μm). As such, GaN-based photonic technology can be used every day in biotech and scientific applications including solid state lighting, detection of bio-agents/drugs/explosives and optogenetics. In the first part of this talk, the author will give a brief overview on band-to-band ultraviolet and visible spectrum light emitting diodes (LEDs) and will be discussing novel integration schemes of such LED technologies to bring affordability and further functionality. In the second part of this talk, the author will be focusing on inter sub-band infrared to Terahertz quantum devices. Terahertz (THz) spectrum offers promising scientific (e.g. cancer detection), industrial (e.g. product defect detection), and military (e.g. explosives detection) applications. Thus yet, generation of THz frequency is rather challenging as it lies at the cusp of electronic and photonic frequencies - creating the so-called "THz gap". Large conduction band offset (~1.8 eV), large longitudinal optical phonon energy (~90 meV), and fast carrier dynamics (~ fs) of GaN compound semiconductors motivate for THz emitters. Finally, the author will summarize recent intersubband device results (i.e., optical modulators and resonant tunneling diodes) and then will move to discussing promising THz emitter schemes. In conclusion, with continuous developments from materials to devices, GaN-based compound semiconductors extend their unique photonic solutions from ultraviolet and visible wavelengths towards THz spectrum.

Biography

Can Bayram received his PhD degree in 2011 from Electrical Engineering and Computer Science Department of Northwestern University, IL with a focus on Solid State and Photonics. His research interests focus on GaN technology and novel photonic devices. He is an expert in the development of InGaN-based visible light emitting diodes and high efficiency III-V solar cells, and is interested in novel growth and fabrication technologies. He is the recipient of distinguished world-wide awards, has more than 100 scientific contributions, and is an active reviewer for journals and agencies. He also serves on the conference program and fellowship committees regularly.

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