

Title: Device Physics and Applications of Intersubband Transitions in Wide-Bandgap Nitride Semiconductors

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Abstract:

Intersubband transitions in semiconductor quantum structures (i.e., electronic transitions between quantized states derived from the same energy band) offer unique opportunities for the development of new device concepts and applications in optoelectronics. In particular, extensive work with As-based quantum wells in the past several years has led to the creation of an entirely new class of light emitters and photodetectors (quantum-cascade lasers and quantum-well infrared photodetectors), currently providing unparalleled performance at mid-infrared wavelengths. In this talk I will review our recent work aimed at extending the spectral range and functionality of intersubband devices using novel materials systems – most notably GaN-based quantum wells. These heterostructures can accommodate intersubband transitions at near-infrared fiber-optic-communication wavelengths, and we have used them to demonstrate all-optical switching with ultrafast (sub-picosecond) response times and concomitantly low switching energies. Furthermore, we have demonstrated optically pumped intersubband light emission from GaN/AlN quantum wells at the record short wavelength of about 2 μm . Finally, the potential of nitride semiconductors in the area of THz quantum-cascade sources, related to their characteristically large optical phonon energies, will also be discussed.

Bio:

Roberto Paiella is an Associate Professor of Electrical Engineering and Participating Faculty of the Division of Materials Science and Engineering at Boston University. His research interests lie in the areas of semiconductor quantum structures, terahertz photonics, and plasmon-enhanced optoelectronic devices. He received a B.S. and M.S. degree in Electrical Engineering from Columbia University and a Ph.D. degree in Applied Physics from Caltech, and prior to joining Boston University he was a post-doctoral research scientist at Bell Laboratories, Lucent Technologies. Dr. Paiella has co-authored over 50 refereed journal papers, over 40 conference papers, and 5 patents, and has edited a book entitled Intersubband Transitions in Quantum Structures.