

# **Hybrid Nanomaterials for Infrared Photodetection**

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## **Abstract**

Infrared (IR) detectors are used in a range of imaging applications, including environmental monitoring, medical diagnosis, and space science. A significant reduction in the cost of IR camera systems is possible if traditional cooling systems, such as liquid-nitrogen dewars, are replaced by thermo-electric coolers. Such a design change requires the development of an IR photodetector that operates at elevated temperatures ( $\geq 120$  K). For infrared photodetectors using intersubband transitions, quantum dots (QDs) are embedded in a matrix material of higher bandgap for carrier confinement and discrete energy levels with separation in the IR range. Quantum dot infrared photodetectors (QDIPs), a relatively new technology, have great potential to provide the requisite detector array performance at high temperatures due to three-dimensional quantum confinement of the detector active region. The purpose of this work is to explore two classes of QDs for hybrid nanomaterial device heterostructures applied to IR photodetection; colloidal QDs (CQDs) synthesized by chemical reactions and Stranski-Krastanow (S-K) QDs grown by strained-layer epitaxy. During my talk, I will discuss: 1) the unique properties of quantum dots that are beneficial for IR detection, 2) the control of dopant incorporation in S-K QDs for improved device performance, 3) the concept of hybrid nanomaterials using CQDs for multi-spectral IR detection, and 4) the preliminary characterization of CQD/polymer nanocomposites on GaAs substrates.

## **Biography**

Adrienne D. Stiff-Roberts is an Assistant Professor in the Department of Electrical and Computer Engineering at Duke University. Her research interests encompass the epitaxial growth and characterization of bulk and quantum-confined semiconductor materials, as well as the design, fabrication, and characterization of optoelectronic and photonic devices, particularly in the infrared regime. Dr. Stiff-Roberts received both the B.S. degree in physics from Spelman College and the B.E.E. degree in electrical engineering from the Georgia Institute of Technology in 1999. She received an M.S.E. in electrical engineering and a Ph.D. in applied physics in 2001 and 2004, respectively, from the University of Michigan, Ann Arbor, where she investigated high-temperature quantum dot infrared photodetectors. Dr. Stiff-Roberts received the David and Lucile Packard Foundation Graduate Scholars Fellowship and the AT&T Labs Fellowship Program Grant from 1999-2004. She is a member of Phi Beta Kappa, Sigma Pi Sigma, and IEEE.