Title: Development of Plasmon Assisted Quantum DOT Sensors for

Multispectral and Polarization Selective Imaging

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Summary:
Remote sensing, imaging and communications are essential for surveillance, strategic planning and battlefield assessment. These activities in turn underlie virtually every DoD mission. Electro-optical (EO) sensors are a critical component of these activities and are employed to provide high spatial and spectral resolution as well as high sensitivity and fast temporal response. This research explores quantum dot (QD) photodetectors (PD) for enhancing the fundamental strengths of EO sensors at the pixel level. The research also explores alternate sensing modalities such as polarization sensing. Furthermore, new practical functionality and signal processing approaches can be discovered with our improved understanding of QDs in plasmonic nanostructures.

Spectral and polarization sensitive EO sensors provide unique remote sensing capabilities such as material classification and target identification. A new sensing modality is the pixel-level device where structures are integrated at pixel sites in a focal plane array to provide multispectral and polarimetric selective sensing. The objective of the proposed research is the investigation and development of subwavelength plasmon-polariton assisted quantum dot (QD) photodetectors (PDs) for pixel-level spectral and polarization sensing.

Our approach for advancing this EO detection technology involves both theoretical modeling and experimental fabrication and testing. The specific objectives of the proposed research include:

1. investigation of absorption enhancement by the interaction between slow plasmonpolaritons and quantum dots in QD PDs
2. utilization of the extraordinary optical properties of a plasmonic antenna
3. advanced bandgap engineering of a QD PD via quantum size effects
4. enhanced quantum efficiency through surface customization of QDs
5. development of device characterization setups for high-speed measurement and dispersion characterization.

This research does not just provide ultrasenstivity and polarization selectivity in photodetection but also contributes significantly towards the understanding of the role of

surface plasmon polaritons in the generation and transport of optically generated carriers in nanoscale QD PDs. In the presence of highly localized plasmon-polaritons in the proposed antenna, photogenerated carriers in QDs can be efficiently collected through the slow-light-assisted electron tunneling process, which will open a new research direction in the study of excitonic nonlinear processes in QDs.