Enhanced Performance Of GaAs Photodetectors Through Thermo-Plasmonic Effects

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Abstract

The study of light interaction with metal micro/nano sized particles and doped semiconductor interfaces represents an exciting area of research with significant implications for nanophotonics and optoelectronics. This project investigates the plasmonic enhancements that emerge from these interactions, leading to the formation of electrodynamic hotspots. Our goal is to design and investigate a novel thermo-plasmonic photodetector that harnesses thermo-opto-electronic processes to generate electron-hole pairs. This mechanism complements the electron-hole pair generation in the bulk of the PIN photodetector when exposed to light. Furthermore, the project aims to enhance plasmonic current-voltage characteristics influenced by factors such as particle size, shape, wavelength range, and doping concentration. The overall investigation of the device is achieved through the development of a thermo-electro-optical model using COMSOL Multiphysics. The device is specifically designed to operate within the Near-Infrared Light (NIR) region. Our findings hold promise for significant advancements in the design and capabilities of light-harvesting and light-emitting devices, including photodetectors, solar cells, and nanoscale light sources.