JOURNAL OF APPLIED PHYSICS **109**, 043108 (2011)

# Heterojunction plasmonic midinfrared detectors

M. S. Shishodia and A. G. Unil Perera[a)]
*Department of Physics and Astronomy, Georgia State University, Atlanta, Georgia 30303, USA*

(Received 29 October 2010; accepted 8 December 2010; published online 25 February 2011)

In view of the emergence of wide ranging applications in the areas such as environmental monitoring, medical diagnostics, defense, security and sensing etc., it is indispensable to develop resourceful mid-infrared photodetectors. In this article, we present potential design considerations exploiting plasmonic effects in the conventional heterojunction mid-infrared detectors, optimized for their operation in 8–14 $\mu$m spectral range. Design issues concerning GaAs-AlGaAs based plasmonic photodetectors are investigated using modal expansion method (MEM) in conjunction with Rayleigh expansion. Simple but insightful fitting expressions useful for designing practical photodetectors are presented. The effects of crucial design parameters on the photodetector performance are discussed in detail. Using metallic grating based plasmonic element, about 20 fold absorption enhancement is predicted, which is comparable or greater than that recently reported for InAs (Quantum Dots) and GaInNAs (Quantum Well) detectors. Photodetector designs showing considerable improvement in the responsivity and the specific detectivity, compared to their nonplasmonic but otherwise identical counterpart are presented. © *2011 American Institute of Physics*. [doi:10.1063/1.3548896]