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Resonant cavity enhanced quantum ring photodetector at 20 μm wavelength

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Abstract In this paper, in order to enhance the performance characteristics of photodetector, an InAs/GaAs quantum ring infrared photodetector (QRIP) with resonant cavity structure is proposed. For this purpose, distributed bragg reflectors (DBR) in the bottom of structure are used to reflect the transmitted beam back into the active region. For further confinement of light in the active region, a gold layer is added to structure as top reflector and the performance of structures is compared with and without top reflector. Numerical simulation results show that using resonant cavity structure can improve quantum efficiency and responsivity of photodetector. Furthermore, the specific detectivity of device can increase about one order of magnitude using resonant cavity structure. Results show specific detectivity, D*, about $\sim 10^{11}$ (cm $Hz^{1/2}$/W) for conventional QRIP and $\sim 10^{12}$ (cm $Hz^{1/2}$/W) for conventional QRIP embedded in resonant cavity. As a result of enhancement in detectivity, the operation temperature of detector can be increased up to about 150 K.

Keywords Quantum ring infrared photodetector · Resonant cavity · Quantum efficiency · Responsivity · Detectivity

1 Introduction

Mid and far infrared (3–20 μm) quantum detectors have been studied extensively because of their wide applications in astronomy, medicine and target tracking (Kochman et al. 2003;

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