Resonant Cavity Enhanced Photodiodes in the Short-Wave Infrared for Spectroscopic Detection

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Abstract:

The design, fabrication and characterization of resonant cavity enhanced photodiodes for the short-wave infrared has been investigated. An InGaAsSb absorber and AlGaSb barrier were used in an nBn structure, within a Fabry-Perot cavity bounded by AlAsSb/GaSb DBR mirrors. The resonant cavity design produced a narrow response at $2.25\ \mu\mathrm{m}$, with a FWHM of ~26 nm and peak responsivity of 0.9 A/W. The photodiodes exhibited high specific detectivities and low leakage currents at 300 K - $5 \times 10^{10}\ \mathrm{cmHz^{1/2}W^{-1}}$ and 0.2 mAcm $^{-2}$ respectively, with an applied bias voltage of −100 mV. A maximum specific detectivity of $1 \times 10^{11}\ \mathrm{cmHz^{1/2}W^{-1}}$ was achieved at 275 K and the detector continued to perform well at high temperatures - at 350 K the peak specific detectivity was $3 \times 10^{9}\ \mathrm{cmHz^{1/2}W^{-1}}$. The narrow resonant response of these detectors make them suitable for spectroscopic sensing, demonstrated by measurements of glucose concentrations in water. Concentrations as low as 1 % were discriminated, limited only by the associated electronic systems.