Gated nanopillars for uncooled tunable infrared detectors

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Uncooled infrared (IR) detectors are required for low-cost, lightweight sensor systems that have both military and commercial applications. Unfortunately, fast Auger recombination rate in the interband detectors makes it impossible to use these detectors at room temperature.

Using bandgap engineering, we have developed a new type-II superlattice detector design [1] with suppressed Auger processes. The experimental results show nearly one order of magnitude lower Auger recombination rate at room temperature in such detectors compared to typical intrinsic (HgCdTe) detectors with similar bandgap. Photoconductors based on this design show a detectivity of $1.3\text{x}10^{8}$ $\text{cmHz}^{1/2}/\text{W}$ at 11 ?m at room temperature [2], while photodiodes show a zero-bias detectivity of $1.2\text{x}10^{8}$ $\text{cmHz}^{1/2}/\text{W}$ at 8 ?m at room temperature [3]. These values are comparable to the detectivity of microbolometers. However, the measured response time of the detector is less than 60 ns, which is more than five orders of magnitude faster than microbolometers. Similarly, we obtained excellent results for devices with cutoff wavelengths above 16 ?m for the first time [4].

With the encouraging results we have for uncooled type II detectors, we propose the possibility of a new technique for lateral confinement of electrons in type-II superlattices. We have achieved very uniform array of 500 nm diameter pillars by dry etching technique. By putting gate voltage on the side of the pillars, the allowed energy states of the electron states can be changed and hence the cut-off wavelength. A widely tunable infrared detector covering mid and long wavelength infrared range is proposed based on these gated pillars.

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