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Voltage-tunable IR photodetector based on asymmetrically doped coupled quantum wells[1] JAE KYU CHOI, NIZAMI VAGIDOV, ANDREI SERGEEV, GOTTFRIED STRASSER, FEDIR VASKO, VLADIMIR MITIN, Electrical Engineering Department, University at Buffalo, SUNY — We report on the mid-IR two-color photodetector with spectral photoresponse tunable by biased voltage. The device is based on GaAs/AlGaAs asymmetrically doped coupled quantum well structures grown by molecular beam epitaxy. A single unit of the detector is composed of 6.5 nm-thick GaAs layer doped with Si up to 5×10^{11}cm^{-2} and 6.5 nm-thick undoped GaAs separated by 3.1 nm-thick $Al_{0.2}Ga_{0.8}As$. Units are separated by 50 nm-thick $Al_{0.2}Ga_{0.8}As$ barriers. Our devices consist of 25 identical units. We demonstrated that in temperature range 20 - 70 K the peak detection wavelengths can be switched from 7.5 μm to 11.1 μm by varying bias from -5 V to +5 V. Our modeling shows that spectral tunability is basically determined by three factors. First, electron energy levels are shifted due to Stark effect. Second, electric field leads to the charge redistribution in the coupled wells and electron energy levels are shifted by electron-electron interaction. Third, tunneling processes from photoexcited quasi-localized electron states in wells to conducting states are enhanced in the electric field due to Fowler-Nordheim effect. The modeling results are in very good agreement with the experimental data. The proposed detectors are promising candidates for adaptive tunable sensing in the IR range.

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