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Low-frequency noise properties of *p*-type GaAs/AlGaAs heterojunction detectors

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HIGHLIGHTS

- At low temperature and low bias, the G-R type shot noise masks all other noise components.
- Grading the barrier of GaAs/AlGaAs heterostructures enhances the escape probability of carriers.
- Detectivity can be improved by optimizing emitter thickness and increasing escape probability.

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ABSTRACT

We have measured and analyzed, at different temperatures and bias voltages, the dark noise spectra of GaAs/AlGaAs heterojunction infrared photodetectors, where a highly doped GaAs emitter is sandwiched between two AlGaAs barriers. The noise and gain mechanisms associated with the carrier transport are investigated, and it is shown that a lower noise spectral density is observed for a device with a flat barrier, and thicker emitter. Despite the lower noise power spectral density of flat barrier device, comparison of the dark and photocurrent noise gain between flat and graded barrier samples confirmed that the escape probability of carriers (or detectivity) is enhanced by grading the barrier. The grading suppresses recombination owing to the higher momentum of carriers in the barrier. Optimizing the emitter thickness of the graded barrier to enhance the absorption efficiency, and increase the escape probability and lower the dark current, enhances the specific detectivity of devices.