E1-05: Dark current reduction in long wavelength qnantum well infrared photodetectors

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GaAs quantum well infrared photodetectors (QWIPs) which utilize the intersubband transitions are excellent for the detection of infrared radiation in the 6 - 18 μm spectral range. These detectors meet most of the performance requirements of long wavelength IR imaging systems including high detectivity, high uniformity, radiation hardness and low power dissipation. However the main problems associated with very long wavelength QWIPs ($> 12 \mu m$) is the high dark current which adversely affects detector performance. This is due to the lower barrier of the quantum well which is a requirement to keep the photoexcitation energy in the very long infrared range while keeping the excited level above the barrier. By theoretically analysing the dark current of shallow quantum wells which were designed for very long wavelength operation, it is realized that the total tunneling contribution of the dark current (sequential tunneling + thermionic assisted tunneling) is significantly higher than its thermionic contribution. The electrons associated with these two tunneling current components are lower in energy compared to photoexcited electrons. These calculations allow us to choose an additional wide $Al_xGa_{1-x}As$ barrier between quantum well structure and one contact layer, that can act as an energy filter to reduce sequential tunneling and thermionic assisted tunneling contributions.