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Analysis of Temperature Dependence of Dark Current Mechanisms in Mid-Wavelength Infrared pin Type-II Superlattice Photodiodes

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We report on the temperature dependence characteristics of mid-wavelength InAs/GaSb type-II superlattice photodiodes in a temperature range from 120 to 240 K. The bulk material model with an effective bandgap of superlattice material has been used in the modelling of the experimental data. Temperature and bias-dependent differential resistances have been analyzed in detail owing to the contributing mechanisms that limit the electrical performance of the diodes. The C1-HH1 reduced mass has been estimated from the fitting to the high reverse bias (< –1.0 V) voltage and given as about 0.015 m_0 in nearly the entire considered temperature range. This value agrees well with much more complex simulations and cyclotron resonance measurements. Obtaining very good results was possible, thanks to the inclusion of series resistance into the calculations. In this paper, we show how to overcome difficulties with the nonlinear problem related to it.

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