文献

Peng, X., Guo, X., Zhang, B., Li, X., Zhao, X., Dong, X., Zheng, W., Du, G.
Numerical analysis of the short-circuit current density in GaInAsSb thermophotovoltaic diodes
(2009) *Infrared Physics and Technology*, 52 (4), pp. 152-157. 被引用数 2 回.

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抄録 (Abstract)
In this paper, a simulation and analysis on the short-circuit current density (J sc) of the P-GaSb window/P-Ga xIn 1-xAs 1-ySb y emitter/N-Ga xIn 1-xAs 1-ySb y base/N-GaSb substrate structure is performed. The simulations are carried out with a fixed spectral control filter at a radiator temperature (T rad) of 950 °C, diode temperature (T dio) of 27 °C and diode bandgap (E g) of 0.5 eV. The radiation photons are injected from the front P-side. Expressions for minority carrier mobility and absorption coefficient of Ga xIn 1-xAs 1-ySb y semiconductors are derived from Caughey-Thomas and Adachi's model, respectively. The P-Ga xIn 1-xAs 1-ySb y emitter with a much longer diffusion length is adopted as the main optical absorption region and the N-Ga xIn 1-xAs 1-ySb y base region contribute little to J sc. The effect of P-GaSb window and P-Ga xIn 1-xAs 1-ySb y emitter region parameters on J sc is mainly analyzed. Dependence of J sc on thickness and carrier concentration of the window are analyzed; these two parameters need to be properly selected to improve J sc. Contributions from the main carrier recombination mechanisms in the emitter region are considered; J sc can be improved by suppressing the carrier recombination rate. Dependence of J sc on the carrier concentration and layer thickness of the emitter P-region are also analyzed; these two parameters have strong effect on J sc. Moreover, adding a back surface reflector (BSR) to the diode can improve J sc. The simulated results are compared with the available experimental data and are found to be in good agreement. These theoretical simulations help us to better understand the electro-optical behavior of Ga xIn 1-xAs 1-ySb y TPV diode and can be utilized for performance enhancement through optimization of the device structure.

著者キーワード
Diodes; Ga xIn 1-xAs 1-ySb y; Short-circuit current; Thermophotovoltaic

文献タイプ: Article
情報源: Scopus