P1_030 Low frequency noise in p-InAsSbP/n-InAs infrared photodiodes at 300K and 77K

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Text The number of applications of mid-IR A3B5 photodetectors continuously grows. One of important characteristics of photodetectors is a low frequency noise since it affects their specific detectivity. Noise analysis is also a well-known tool to characterize the material quality and device reliability. Here, we present the first experimental study of low-frequency noise in p-InAsSbP/ n-InAs mid-IR photodiodes at 300K and 77 K. Epitaxial structures lattice matched to InAs were similar to those previously studied in details in [1]. At room temperature, all samples exhibited maximum photoresponse at wavelength 3.4 μm which decreased by 10% at 3.6 μm [1]. Spectral noise density measurements were carried out in the frequency range 0.5-10 kHz at 300K and 77K. We have measured the current noise in forward biased diodes without illumination (forward-bias mode) and the photocurrent noise in photovoltaic mode (at zero bias). At 300 K, the current-voltage characteristic is well described by the thermionic theory. For both modes, photovoltaic mode and forward-bias mode, the noise spectrum has a 1/f form. At low photocurrents and high frequencies of analysis the noise approaches the thermal (Nyquist) noise. At currents less than saturation current Io the spectral noise density SI is proportional to ~ I^2 showing that the noise originates from the resistance fluctuations of the photodiode. For I higher than Io, SI is proportional to I. At 77 K, the current-voltage characteristic reveals the presence of local defects in the proximity of the barrier. The noise spectral density is significantly higher than at 300K, and Lorentzian contributions to 1/f noise are observed. We suppose that the barrier height inhomogeneities manifested in I-U characteristics are responsible for the noise growth at low temperature [2, 3]. The current dependences of spectral noise density can be approximately described as SI~ I^1.5 and show particularities suggesting the contribution of defects. This work was supported by French Ministry of Education and European Commission through the ERA.Net RUS Plus project Terasens and by CNRS through LIA TeraMIR project. [1] P. N. Brunkov, et al., Semiconductors, vol. 48, no 10, pp. 1359-1362, 2014. [2] H. Ouacha, et al., Appl. Phys. Lett., vol. 69, pp. 2382-4, 1996. [3] S. T. Hsu et al., IEEE Trans Electron Dev., vol. 18, pp. 882-7, 1971.