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Parameter determination from current–voltage characteristics of HgCdTe photodiodes in forward bias region

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Abstract Current–voltage characteristics of HgCdTe photodiodes in the forward bias region have been modeled considering mechanisms including drift-diffusion current, recombination current, metal-semiconductor contact and constant series resistance. Moreover, a fitting method based on the genetic algorithm has been developed to obtain values of related physical parameters from the measured dynamic resistance–voltage curves. Fitting results of n^+-on-p planar devices with different cutoff wavelengths are presented to illustrate the model and method, which are available and promising in acquiring device parameter values and evaluating the electrode contact quality.

Keywords Current–voltage characteristics · HgCdTe photodiode · Forward bias · Composition gradient · Metal-semiconductor contact

1 Introduction

Mercury cadmium telluride (HgCdTe) is currently the most widely used material for infrared (IR) detection, due to its advantages including continuously tunable bandgap, high electron mobility and the potential to operate at high temperatures (Rogalski 2005; Wang et al. 2011) over other materials (Guo et al. 2011, 2012). Unfortunately, detectors based on this material suffer from very complex fabrication processes as well as fairly subtle influences of various factors (Ye et al. 2011; Hu et al. 2011, 2012; Chen et al. 2012; Yin et al. 2009). Therefore, feasible models are required to describe state-of-the-art device performance, and to enable determination of useful physical parameters from routine tests such as the spectral response and the current–voltage (I–V) measurements.

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