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Analysis of the mechanisms of electron recombination in HgCdTe infrared photodiode

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Abstract This paper presents an experimental study of minority carrier lifetime and recombination mechanisms in HgCdTe photodiode. The excitation light source is a wavelength-tunable pulsed infrared laser. A constant background illumination has been introduced to minimize the effect of the junction equivalent capacitor and resistance. The decay of the photo-generated voltage is recorded by a storage oscilloscope. By fitting the exponentially decay curve, the time constant has been obtained which is regarded as the photo-generated minority carrier lifetime of the HgCdTe photodiode. The experimental results show that the carrier lifetime is in the range of 18–407 ns at 77 K for the measured detectors of four Cd compositions. It was found that the Auger recombination process is more effective for low Cd composition while the radiative recombination process became more important for high composition materials. The Shockley–Read–Hall recombination processes could not be ignored for all Cd composition.

Keywords HgCdTe · Open circuit photovoltage · Minority carrier lifetime · Recombination mechanism

1 Introduction

HgCdTe is the preferred material for detectors and focal plane arrays over a broad range of the infrared spectrum (Chen et al. 2012; Hu et al. 2011a). Even though HgCdTe has been studied extensively for infrared detector (Yin et al. 2009; Hu et al. 2009, 2011b), there is still a great deal of ambiguity issues, such as the minority carrier lifetime and its dominating recombination mechanisms (Schacham and Finkma 1985). This is because of the instability of HgCdTe, which the material property may be changed during the formation process of pn junction. Therefore, the parameter of the raw material can not be applied to estimate the

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