# High quantum efficiency SWIR HgCdTe detectors

N.D. Akhavan[1*], G.A. Umana-Membreno[1], R. Gu[1], J. Antoszewski[1] and L. Faraone[1]
[1]School of Electrical, Electronic and Computer Engineering, The University of Western Australia, Crawley, WA 6009, Australia
*Corresponding author: Email nima.dehdashti@uwa.edu.au

**Abstract Summary:** In this work we present the design principles for high quantum efficiency HgCdTe based infrared photodetectors operating in the short wave infrared (SWIR) band of 2-3µm. The detectors are designed to achieve quantum efficiency of higher than 90% with a TE cooler assembly (T>220 K).

**Introduction:** Over the past decade, there has been increasing interest in SWIR sensing beyond 1.7µm; an interest that is driven by many emerging applications in defence, science and industry [1]. This has motivated a surge in competing research efforts focused on developing high-performance strained InGaAs-based photodetectors with cut-off wavelengths up to 2.7µm, and high-performance HgCdTe IR sensors with cut-off wavelength below 3µm [2].

Design and fabrication: The detector in this study is a planar n-on-p photodetector where the absorber mole fraction is chosen to be x=0.50 which corresponds to the cut off wavelength of λco=2.2 µm at 300K. The p-type absorber layer is grown by molecular beam epitaxy (MBE) and is vacancy doped. The n-type region can be formed by either ion-implantation or reactive-ion-etching (RIE) process. In order to achieve high quantum efficiency (QE>90%), understanding the fundamental mechanisms which contribute to the dark current and careful design of the absorber thickness is essential. Figure 1 shows the measured responsivity (normalised) which clearly indicates that he detector is tuned to have a λco=2.2 µm at T=300K. Figure 2 shows the comparison of measured zero bias dynamic resistance ($R_0A$) with the best reported SWIR detectors at T=300K. It is evident that our passivation technology is comparable to the best reported SWIR detectors from other laboratories [3].

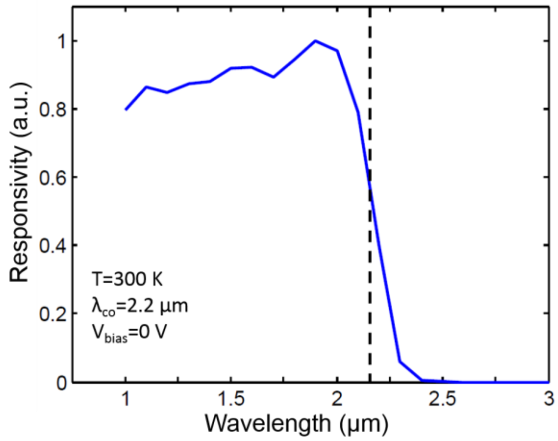


Figure 1. Normalized Responsivity curve at room temperature for $Hg_{1-x}Cd_xTe$ detector with x=0.50 which corresponds to 2.2 µm cut off wavelength.

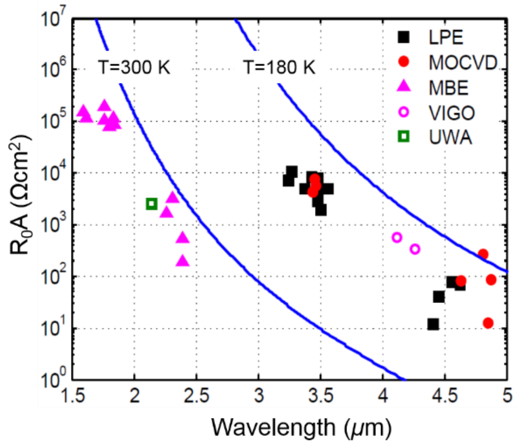


Figure 2. $R_0A$ of high performance single detectors reported by different laboratories. It is evident that the performance of detectors fabricated at UWA match those fabricated by best reported detectors. The solid lines represent the theoretical limit for $R_0A$ due to Auger and Radiative mechanisms.

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