High performance Infrared Photodetectors for Sensing Applications

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The modern infrared (IR) thermal imaging systems is governed by the development of mega pixel array of photodetectors for different spectral bands. The main semiconductor material in this arena is the $Hg_{1-x}Cd_xTe$ alloy where it bandgap can be tuned by changing the alloy composition x and therefore can cover a wide range of spectral bands from ~1 µm to ~15 µm. In this work we present the latest development in high performance HgCdTe based infrared photodetectors operating in the short midwave infrared (MWIR) band of 3-5 µm. These detectors are fabricated using the molecular beam epitaxy and clean room facility available at the Microelectronic Research Group of at the University of Western Australia. The plasma-induced type conversion using reactive ion etching (RIE) process has been used to make n-on-p junction [1-3].

Figure 1 shows the schematic of the RIE fabricated junction along with the typical doping profile and Cd composition (x) in a MWIR $Hg_{1-x}Cd_xTe$ detector structure. Preliminary results show that that the R_0A is limited by analytical expression of GR current in the depletion region of the photodetector and according to this figure, the lifetime of minority carriers are in the order of ~100 ns in the n- layer.

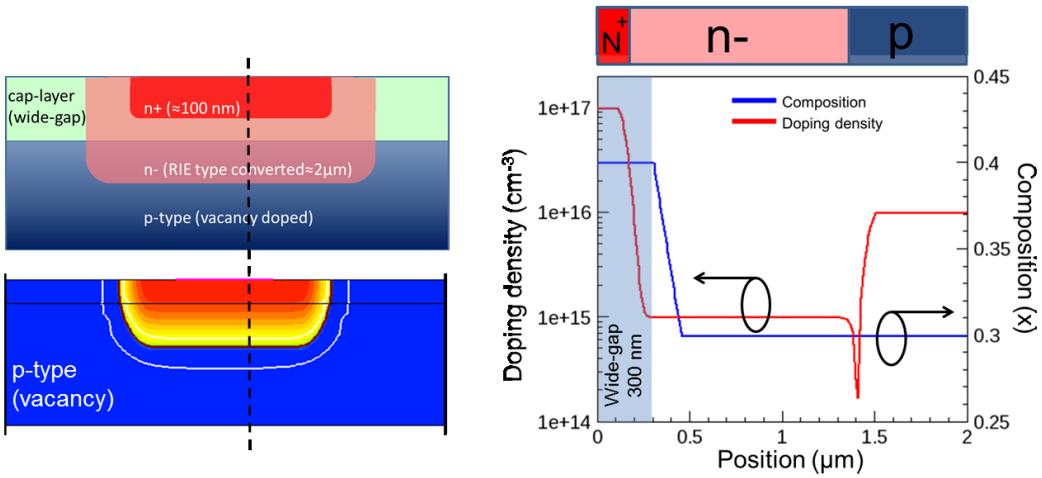

Figure 1. (left) Schematic of the planar infrared photodetector with RIE formed junction. (right) Doping density profile and Cd composition (x) for a MWIR detector.

[1] Antoszewski, J., Musca, C.A., Dell, J.M. et al. Small two-dimensional arrays of mid-wavelength infrared HgCdTe diodes fabricated by reactive ion etching-induced p-to-n-type conversion. J. Electron. Mater. 32, 627–632 (2003).

[2] Dell, J.M., Antoszewski, J., Rais, M.H. et al. HgCdTe mid-wavelength IR photovoltaic detectors fabricated using plasma induced junction technology. J. Electron. Mater. 29, 841–848 (2000).

[3] J. F. Siliquini, J. M. Dell, C. A. Musca, and L. Faraone , "Scanning laser microscopy of reactive ion etching induced n-type conversion in vacancy-doped p-type HgCdTe", Appl. Phys. Lett. 70, 3443-3445 (1997) https://doi.org/10.1063/1.119159.