# Light Beam Induced Current and Electron Beam Induced Current measurements of Mercury Cadmium Telluride n-on-p photodetectors

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Mercury Cadmium Telluride (MCT) is regarded as the best material for high-performance infrared (IR) sensors and imaging arrays. MCT offers a unique combination of favourable properties for IR photon detection such as a tuneable bandgap that enables sensing of IR radiation with wavelength ranging from 0.8 μm to >20 μm, optical coefficients that enable high quantum efficiency detectors, and intrinsic recombination mechanisms that favour the fabrication of high operating temperature (HOT) detectors [1]. While the soft-brittle nature of MCT and the low binding energy of the Hg-Te bonds present significant device fabrication challenges to MCT-based IR technology, innovative n-on-p junction formation processes (that exploit the weak nature of the Hg-Te bonds) have been developed to realise high performance IR detectors and imagers. UWA pioneered Reactive Ion Etching (RIE) as a viable method for n-on-p junction formation that relies on type conversion from p-type to n-type [2]. The type-conversion process appears to be similar to that induced by Ion Beam milling, where physical ion-bombardment at the surface leads to breaking of Hg-Te bonds at the Hg-Te sublattice and drives Hg species deeper into the material as interstitials. Thus, in p-type material, RIE generates a shallow, damaged and highly doped n-type surface with an underlying low n-type doped region. UWA recently demonstrated high performance IR imaging arrays fabricated employing RIE-based junction formation technology [3]. While the low n-type doped region induced by RIE offers the possibility of enabling ultra-high quantum efficiency IR sensors and higher operating temperatures, such gains in performance demand greater insight into the effects of RIE type conversion on devices parameters and the influence of as-grown and RIE induced defects.

To gain insight into the RIE type conversion process and n-on-p photodetector characteristics, RIE-formed n-on-p junctions have been investigated employing Light and Electron Beam Induced Current measurements (LBIC and EBIC, respectively). LBIC and EBIC are well documented characterisation methods for semiconductor materials, however LBIC is the preferred method for visualisation of junctions in MCT since high-energy electrons often employed in EBIC studies tend to introduce surface damage. In this work we will present results of a LBIC and EBIC study of MCT n-on-p planar structures, as well as cross-sectional EBIC imaging undertaken at cryogenic temperatures (to minimise electron beam induced damage).

[1] A. M. Kinch, *J. Electron. Mater.* **29**, 17 (2000).

[2] J. Antoszewski et al., *J. Electron. Mater.* **29**, 837 (2000).

[3] R. Gu et al., Proc. 2018 COMMAD, pp. 11-12 (2018,)