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K. Roodenko, K.K. Choi, K.P. Clark, E.D. Fraser, K.W. Vargason, J.M. Kuo, Y.C. Kao, P.R. Pinsukanjana

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Control over the optical and electronic performance of GaAs/AlGaAs QWIPs grown by production MBE

K. Roodenko[a], K.-K. Choi[b], K. P. Clark[a], E. D. Fraser[a], K. W. Vargason[a], J.-M. Kuo[a], Y.-C. Kao[a], P. R. Pinsukanjana[a]

[a]Intelligent Epitaxy Technology, Inc., 1250 E. Collins Blvd, Richardson, Texas, 75081 USA

[b]Electro-optics and Photonics Division, US Army Research Laboratory, 2800 Powder Mill Road, Adelphi, MD 20783, USA

ABSTRACT

Commercial production of quantum well infrared detectors (QWIPs) requires targeting specific detector dark current densities and cutoff wavelengths. Molecular beam epitaxy (MBE) allows a tight control over the quantum-well structure. This manuscript discusses the growth of the long-wave infrared (LWIR) QWIP detectors on the multi-wafer MBE reactors at IntelliEpi. We address the tuning of the cutoff wavelength by adjusting of the thickness of the GaAs quantum well (QW) layer and the composition of the AlGaAs barrier. The control over the dark current densities is examined through the correlation with the doping levels and the detector cutoff wavelength.

Keywords: QWIP, infrared, doping, MBE, epitaxy, FTIR

Research highlights {obligatory part, max 85 characters per highlight incl. spaces}

- Industrial production of QWIPs on multi-wafer production MBE systems is discussed.
- Calibration routines and characterization methods are presented.
- Reproducible growth of variety of QWIP structures is demonstrated.

1. INTRODUCTION

Fabrication of focal plane arrays (FPAs) based on quantum well infrared photodetectors (QWIPs) had been extensively pursued across a broad IR detection wavelength range, from mid-wavelength (MW) to very long wavelength (VLW) [1,2,3]. From the manufacturing point of view, QWIP based on GaAs/$Al_xGa_{1-x}As$ materials system grown on GaAs substrates is preferred because device/FPA fabrication process can leverage the already well-established GaAs manufacturing infrastructure. This includes the commercial availability of low cost epi-ready GaAs substrates. Currently, GaAs wafer up to 6" in diameter readily available. While QWIP epi wafers have been produced successfully by both molecular beam epitaxy (MBE) [4,5] and metal organic chemical vapor deposition (MOCVD) [6] technologies, MBE generally offers a more abrupt control of hetero-interfaces. The ability to achieve a more "square" conduction band profile is more challenging for MOCVD, particularly for epi structure designs with