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2.5-μm InGaAs photodiodes grown on GaAs substrates by interfacial misfit array technique

Pamela Jurczak[1], Kimberly A. Sablon[2], Marina Gutiérrez[3], Huiyun Liu[1], and Jiang Wu[1,*]

[1] Department of Electronic and Electrical Engineering, University College London, Torrington Place, London, WC1E 7JE, United Kingdom

[2] United States Army Research Laboratory, 2800 Powder Mill Road, Adelphi, Maryland 20783-1197, United States of America

[3] Department of Material Science and Metallurgic Engineering, The University of Cadiz, 11510, Puerto Real, Cadiz, Spain

*Email: jiang.wu@ucl.ac.uk

Abstract

$In_{0.85}Ga_{0.15}As$ photodetectors grown on GaAs substrates using an interfacial misfit array-based simple buffer are studied. The material quality is assessed with a range of characterization tools showing low surface roughness and low density of threading dislocations. These results indicate a significant improvement on crystal quality compared to structures grown on InP substrates by using metamorphic buffers. Quantum efficiency and responsivity measurements show good performance of the fabricated devices between 1.5 and 2.5 μm, making them highly suitable for short-wavelength infrared applications.

Keywords: infrared; photodiodes; epitaxy; interfacial misfit array; short-wavelength

Introduction

InGaAs short-wavelength infrared (SWIR) detectors are widely used in space remote sensing, environment monitoring, night vision, spectroscopy, etc. [1]. The $In_{0.53}Ga_{0.47}As$ photodetectors lattice-matched to InP substrate have a limited cut-off wavelength of 1.7 μm. Among many of these applications, e.g. gas sensing, it is highly desirable to extend the cut-off wavelength beyond 2.5 μm. To meet such a goal, the indium content in $In_xGa_{1-x}As$ must be increased to 80%~85%, which results in a large lattice mismatch (+1.85% ~ +2.2%) between the InGaAs