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Heterostructures on InP substrate for high-speed detection devices over a large spectral range (0.8–1.6 μm)

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Abstract

Semiconductor heterostructures of $A^{III}B^{V}$ type with a bandgap adjustable by composition assure a good detection in a large spectral range of 0.8–1.6 μm, compatible with optical fibre communication spectral range. The paper presents the $In_{0.53}Ga_{0.47}As/InP$ heterostructures, grown by Cl-VPE technique, and their use for fabrication of high-speed photodetectors as PIN photodiodes and Schottky barrier photodetectors. The PIN photodiodes have high value for responsivity, namely 0.3 A/W at 0.8 μm and 0.82 A/W at 1.3 μm wavelength without AR coating. The response time is 150 ps on 50 Ω load resistance, limited by RC constant. For Schottky barrier photodetectors metal sandwiches of Ni/Pd/Au, Ag/Pd/Au and Ti/Pd/Au were deposited on the heterostructures surface. The barrier height in the range (0.42–0.6) eV was obtained by growing a thin interlayer of n-InP over an n-type InGaAs/InP heterostructure. The responsivity of Schottky photodiodes was in the range 0.16–0.25 A/W and the response time under 100 ps.

Keywords: Heterostructure; Photodiode; Cl-VPE epitaxial technique; Schottky barrier

1. Introduction

The heterostructures with $In_{0.53}Ga_{0.47}As$ and InP layers grown on InP substrates allows the realisation of devices having high sensitivity in the 0.8–1.5-μm spectral range and a high-speed operation

The PIN photodiodes and Schottky barrier photodiodes on InGaAs/InP heterostructures are the most suitable devices for long-wavelength optical communications systems due to their high efficiency and their capability for high-speed operation. High-speed photodiodes on $In_{0.53}Ga_{0.47}As/InP$ are extensively studied [1–3] for their monolithic integration with amplification devices, such as FET, HBT or MODFET, in OEICs in high rate data transmission. In this paper we present parameter optimization for a PIN photodiode and a Schottky barrier photodiode, and technological processing for $In_{0.53}Ga_{0.47}As/InP$ heterostructures.

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