Opt Quant Electron (2013) 45:365–371
DOI 10.1007/s11082-012-9639-z

PIN-photodiode with a large spot size input waveguide

Andreas Wieczorek · Hua Yang · Brendan Roycroft · Frank H. Peters · Brian Corbett

Received: 26 July 2012 / Accepted: 16 November 2012 / Published online: 29 November 2012

Abstract Polarization insensitive optical coupling of a large spot size input waveguide to a small spot size photodiode is achieved by the introduction of a transition waveguide. The coupling efficiency to the photodetector and the related absorption efficiency of the photodiode depend mainly on the refractive indices of the different InGaAsP layers. Waveguide alignments, waveguide widths and the n-contact etch depth do not influence the absorption efficiency relative to a 1-dB tolerance.

Keywords Asymmetric twin guide · Photodiode · Fabrication tolerance

1 Introduction

Photodiodes (PDs) are one of the key components in photonic integrated circuits (PICs). They convert received optical signals into electric signals. Side-illuminated PDs offer the advantage of decoupling the carrier transition length and the optical field absorption length. Because the carrier collection path is perpendicular to the optical field, a high efficiency and a short transit time can be achieved simultaneously (Bowers and Burrus 1986). A dielectric free fabrication of photodiodes operating up to 30 GHz was reported (Daunt et al. 2012). However, a mode mismatch between the large circular beam of a cleaved fiber and the small elliptical beam of an InGaAs PIN-PD results in coupling losses of up to 10 dB and a resultant low responsivity. Several approaches were made to solve this problem. The evanescently coupled waveguide PD is one concept that enables high speed operation and high responsivity. The WG-PD consists of a photodiode located on top of a passive waveguide (Beling and Campbell 2009). Beling et al. demonstrated an InP based spot size converter combined with a PD operating with a 120-GHz bandwidth and a responsivity of 0.5 A/W at

A. Wieczorek (✉) · H. Yang · B. Roycroft · F. H. Peters · B. Corbett
Tyndall National Institute, Lee Maltings, Dyke Parade, Cork, Ireland
e-mail: andreas.wieczorek@tyndall.ie

A. Wieczorek · F. H. Peters
Physics Department, University College Cork, Cork, Ireland