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Current sign inverter guided by polarization

I.G. Stamov, N.N. Syrbu, A.V. Dorogan *, L.L. Nemerenco

Technical University of Moldova, MD-2012, 168, Bulevard Stefan cel Mare, Chisinau, Republic of Moldova

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Abstract

In this work, there are studied the photodetectors' properties (photocurrent sign inverter) of a linear polarized radiation realized on the basis of anisotropic semiconductors. The photocurrent sign guiding is made by the changing of polarization plane of a linear polarized light wave. It was determined that the inversion point can be moved over the photon energy scale while applying an external displacement. It is shown in the work the influence of the light wave interference on the properties of the photodetector's photosensibility. It was revealed the possibility of creating narrow band photodetectors with sensibility maximums suitable to be used in fiber optic communications. There had been analyzed some cases of using the guided photocurrent sign inverter in which the active elements are the p–n structures, Schottky diodes and twins.

Keywords: Photoelement; Photodetectors; Photoreceivers; Interference spectra; Schottky diodes

1. Introduction

There is necessary some kind of receivers capable to change the sign from $+J_{ph}$ to $-J_{ph}$ value (and voiceovers) at polarization plane turning up to 90° for determining the oscillation plane of the electrical vector of a plane polarized radiation [1–4]. Such photoreceivers are named as current sign inverters guided by polarization [5,6], or "null-indicators" of polarized radiation [7–9]. Such devices are necessary for many domains of integrated optics, for fiber optic communications (for determining the polarization mode dispersion) and for robotechnics.

In this work are presented the construction particularities and characteristics of photoreceivers for linear polarization radiation based on anisotropic semiconductors such as $ZnAs_2$.

2. Experimental results and discussion

$ZnAs_2$ is a semiconductor that possesses direct transitions and a 1.05 eV band-gap at 10 K [9,10]. The absorption at a 1.35 μm wavelength and $E \parallel c$ polarization increases and the crystals of some hundred micrometers thickness become transparent. The crystals are transparent till the 1.3 μm wavelength at $E \perp c$ polarization. There is revealed sharp boundary absorption (Fig. 1) with 1.29 μm maxima at this wavelength and $E \perp c$ polarization. The absorption edge is displaced forward big energies at a temperature decrease. The temperature displacement factor $\beta = \Delta E/\Delta T$ for $E \parallel c$ polarization is equal to 3.1×10^{-4} eV/deg and that for $E \perp c$ polarization is equal to 4.6×10^{-4} eV/deg.

Figs. 2 and 3 shows transmission spectra of $ZnAs_2$ monocrystals with ~20–22 μm thicknesses obtained from the gas phase and measured at 10 K for $E \parallel c$ and $E \perp c$ polarizations. An intensive Fabrry–Perot interference is observed for both polarizations. The absorption at $E \perp c$ polarization is lower than at $E \parallel c$ polarization, this is why there are observed interference spectra down to 1.3 eV. The interference spectra oscillation amplitude decreases as photon energy increases. The refractive index n is determined from the interference condition

$$n = \frac{M}{2d(\nu_1 - \nu_2)}, \quad (1)$$

* Corresponding author. Tel.: +373 22235437; fax: +373 22 235405.
E-mail address: dorogan.andrei@gmail.com (A.V. Dorogan).

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