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Birefringence of ZnP_2-D_4^8 and Characteristics of Me-ZnP_2 Diodes

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Abstract

Spatial dispersion in ZnP_2-D_4^8 has been studied. The spectral dependences of the refractive index n^c (E||c, k||a), n^a (E||a, k||c) and n^b (E||b, k||c) had been determined. ZnP_2-D_4^8 crystals are isotropic at λ_o=612nm wavelength, in case of crossed polarizators a transmittance maximum is observed. It was shown that the dispersion is positive n^c(E||c,k||a), n^a (E||a,k||c) > n^b(E||b,k||c) in $\lambda>\lambda_0$ region, the dispersion is negative n^c (E||c,k||a) at $\lambda<\lambda_0$, and $\Delta n=n^c-n^b=0$ at $\lambda=\lambda_0$. The LIV characteristics of Me- ZnP_2-D_4^8 diodes had been studied at different temperatures, the temperature dependences of the "imperfection" factor δ for different Schottky barriers. Capacitance voltage characteristics of Me- ZnP_2-D_4^8 photodiodes obtained by electrochemical deposition of metal and by thermo-chemical spraying in vacuum had been studied. The dependence of diffusion potential Φ_B on the work function of the metal ξ_m(C) has been revealed. The influence of birefringence and gyration on spectral characteristics of p-n photodiodes and Schottky diodes had been revealed. The ability of controlling photodiodes' characteristics was obtained using the gyration particularities in ZnP_2-D_4^8 crystals.

Keywords

Semiconductor Compound, Optical Absorption and Reflection Spectra, Optical Constants, Capacitance Voltage Characteristics, Schottky Barrier, Photodiodes

1. Introduction

Zinc diphosphide is a wide gap semiconductor material of A^2B^5 group, which possesses the anisotropy of optical properties with natural gyrotropy [1 – 6]. Devices of quantum electronics and nonlinear optics had been elaborated basing on ZnP_2 crystals, which operating principle is based on gyrotropy and nonlinear crystal polarizability [7 – 12]. The values of nonlinear polarizability and gyrotropy of ZnP_2 are higher than those for other crystals [8, 13]. The low thermal conductivity of ZnP_2 crystals (10 W/m • K) is used to create laser beam deflectors with thermally induced gradient of the refractive index [9, 10]. It was shown the possibility of creating magneto-optical modulators basing on crystals of zinc and cadmium diphosphide, magneto-optical sensors for measuring the magnetic field [11, 13].

The technology for producing p-n junctions based on ZnP_2 crystals, surface barrier diodes was developed [2, 3, 5, 6]. The developed photoresists based on ZnP_2 posses a low relaxation time constant and are suitable for registering impulse radiation flows of $1\cdot10^{-9}$s duration. Photoelectronic emitters and photodiodes, electric switches and Zener diodes had been developed based on ZnP_2 single crystals [14 – 17]. ZnP_2 crystals change the optical activity with temperature change, while maintaining the linear dependence of the rotational ability of polarization plane on the temperature (temperature sensors) [15, 16].

The birefringence properties on perfect, high-quality ZnP_2 crystals, LIV, capacitance-voltage characteristics, and photovoltaic characteristics of p-n-ZnP_2 structures, (n-p-ZnP_2) are studied in this paper, including the characteristics of Me-ZnP_2 diodes and ZnP_2-D_4^8- ZnP_2-C_{2h}^5 heterojunctions. A comparison of the characteristics of the device structures obtained by electrochemical deposition of metal and metal thermo-chemical spraying in vacuum on the surface of the crystals has been made. The influence of the gyration phenomenon on the characteristics of p-n photodiodes and Me- ZnP_2 photodiodes was examined.