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OPTOELECTRONIC CONVERTERS BASED ON APV ELEMENTS

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Abstract
This work examines new applications of APV elements based on narrow-gap semiconductor materials. The physical and technical foundations of photoelectronic converters of deflection systems and optical modulators based on APV elements are analyzed. An optoelectronic device has been developed based on APV - elements with an electro-optical effect, and a sound-controlled light deflection system.

Keywords: optical modulator, abnormally high photoelectric voltage (APV), narrow-gap semiconductor material, optoelectronic conversion of optical signals.

Introduction

The conversion of solar radiation into a coherent optical signal has not yet reached the level necessary for practical application, but due to the huge need for such devices, in this work, various devices based on APV elements suitable for optoelectronic conversion of optical signals are being studied. Figure 1 shows a device based on APV - elements of narrow-gap semiconductor materials. It occurs based on the electro-optical effect. It consists of two transparent electrodes (1 and 2) and thin films of narrow-gap semiconductor (PbS, Ge, PbSe) materials with an anomalously high photovoltage [1-4]. A photovoltage from the optoelectronic protection circuit (3) of solar radiation AE-2 is applied to the electrodes. If an image obtained in natural light is formulated on the surface of electrode 1, then due to birefringence in the inhomogeneous and anisotropic film of the APV element (AE-1), a voltage distribution occurs that repeats the illumination pattern of the image (element). Birefringence depends on the strength of the electric field (intensity), so it will be distributed according to the voltage, repeating the lighting pattern [5-9].

The Main Part

When exposed to linear polarized laser radiation, a change in polarization at the output will repeat the birefringence pattern, that is, the illumination pattern of the incoherent image. By installing an analyzer at the output that transmits light, the plane of polarization of laser radiation, we obtain a coherent image.

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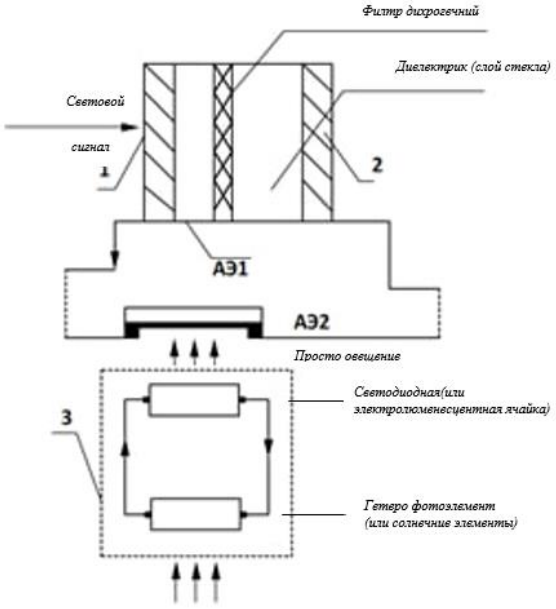

Рис. 1. Оптоэлектронное устройства на основе APV - элементов обладающим с электрооптическим эффектом.

Incoherent image-to-coherent image converters are very effective in holography and in systems performing correlation calculations and real-time Fourier analysis.

When polarized light passes through the APV element, the plane of polarization of the light will rotate. By selecting the strength of the electric field and the direction of the optical axis of the APV element microcrystals, you can rotate the plane of polarization by 900. The amplitude of the light passing through the APV element and the analyzer behind it will change depending on the angle of rotation of the polarization plane. If you replace the analyzer with an APV element with birefringence, you get a polariscope that allows you to analyze polarization or a deflection system. Such devices react even to small changes in the field and are slightly inert. Under the influence of ultrasound, it is possible to change the optical density of the APV element. Thus, the APV element becomes a diffraction grating. Light passing through it will change direction due to refraction and diffraction. If light enters at an angle characteristic of a given grating, then the first order of diffraction will deviate greatly from the original direction of the beam. The deflection angle can be changed by changing the ultrasound frequency. This acoustic-optic effect makes it possible to create a new type of deflection system controlled by sound [10-13]. In Fig.2. shows a block diagram of a sound-controlled deflection system and light modulation. In APV elements, light scattering is negligible, the refractive index is high, and sound absorption and sound speed are low. Therefore, they are most convenient for practical use. A typical example of the use of the acousto-optic effect on APV elements of these materials is the frequency conversion of optical radiation (acousto-optical light modulation). If ultrasonic vibrations are pulses, then the presence or absence of diffraction will correspond to the presence or absence of an ultrasonic pulse, and this is the possibility of digital modulation (of light) of the signal. Since the intensity of diffracted light is proportional to the strength of the ultrasound, changing the amplitude of the ultrasound can control the intensity of the light.

This is how analogue amplitude modulation occurs. When the ultrasound frequency changes, the Doppler shift of the optical vibration frequency changes, which is frequency modulation. Such acoustic devices based on APV elements use a surface ultrasonic wave to simulate light in an optical waveguide.

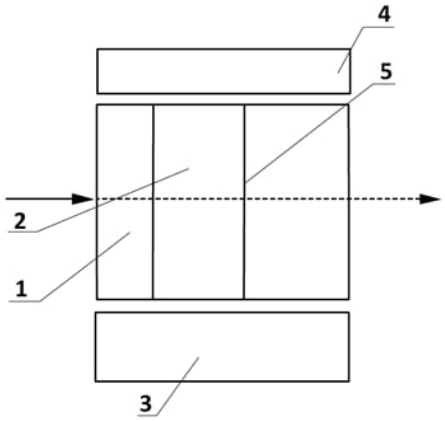

Рис.2. Звуко управляемая отклоняющая система света.

1 - прозрачный электрод (SnO_2);

2 - APV-элемент;

3 - источник плоских ультразвуковых вольн;

4 - Приемник ультразвука.

By passing a light signal through the APV element and applying a magnetic field, you can also rotate the plane of polarization. By means of an analyzer or an APV element with birefringence, it is possible to modulate or deflect light.

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