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Research Article

# INNOVATIVE APPLICATIONS OF APV ELEMENTS IN OPTOELECTRONICS

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## ABSTRACT

This article explores novel design concepts for modulators utilizing the APV (Anisotropic Photovoltaic) effect.

## KEYWORDS

APV Elements, APV Effect, Photovoltaic, Ultrasonic Wave Source, Polarizer, Properties, Amorphous Structure, Crystalline Structure.

## INTRODUCTION

Functional devices are engineered on the principles of functional integration, encompassing solid bodies that emulate the functionalities of optoelectronic or radio-electronic devices. In contrast to conventional circuit electronics, these devices leverage specific solid body properties to merge the functions of various electric and optical circuit elements. Functional devices offer superior potential for enhancing reliability and achieving microminiaturization compared to integrated circuits. This advantage stems from their independence from the elements typically required in integrated circuitry, resulting in fewer local inhomogeneities within the solid body.

APV films are anisotropically deposited onto substrates, introducing optical anisotropy. When exposed to linearly polarized light under an electric field perpendicular to the light's propagation, the refractive indices change.

Consequently, the light's polarization plane rotates by an angle proportional to the optical path length, which can be adjusted by modifying the electric field strength, allowing for a 90° rotation.

Figure 1 illustrates the primary design of a modulator operating based on the fundamental APV effect. The amplitude of light passing through the APV film is contingent on the rotation angle of the polarization plane. Substituting the analyzer with a double-beam refraction plate yields a polarization or deflection system, which is highly responsive to even minor field changes and exhibits minimal inertia.

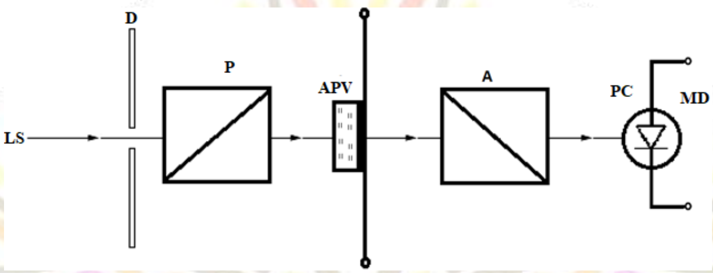


**Figure 1: Block diagram of APV modulator.**

LS - Light Source; P - Polarizer; D - Diaphragm; A - Analyzer; APV - APV Film; PC - Photocell; MD - Measuring Device

Ultrasound can be employed to locally alter the optical density of the APV film's substance, effectively creating a diffraction grating. As light traverses the grating, it changes direction due to diffraction and wavelength reversal. By manipulating the ultrasound frequency, the deflection angle can be adjusted (see Figure 2).

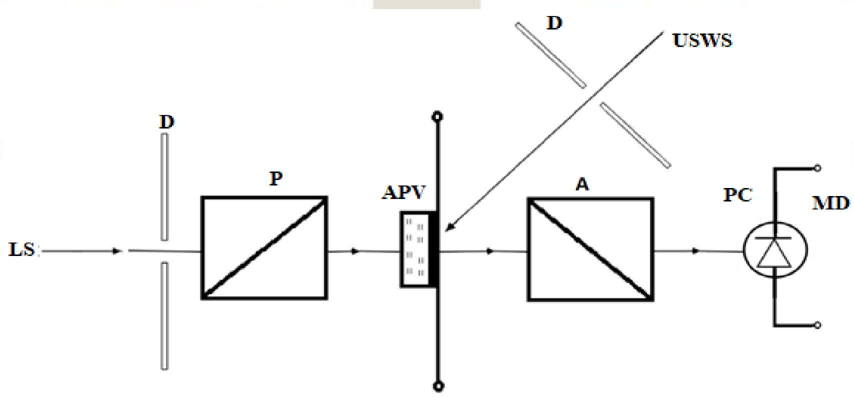


**Figure 2: Block diagram of a polariscope with an ultrasonic source.**

LS - Light Source; P - Polarizer; D - Diaphragm; A - Analyzer; APV - APV Film; PC - Photocell; MD - Measuring Device; USWS - Ultrasonic Wave Source

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Additionally, by passing infrared (IR) light through the APV film and applying a magnetic field, the polarization plane can be rotated. An analyzer or a double refraction plate can then be used to modulate or deflect the light. Furthermore, an electric field can alter the light absorption limit of APV films, creating spectral dependence (known as the Franz-Keldysh effect) in APV-films. This effect enables direct modulation of light within optical waveguides.

Figure 3 demonstrates the design of a modulator using the APV film (APV2) as the electric field source, simplifying the device's architecture and rendering it non-volatile, thus eliminating the need for an external power source.

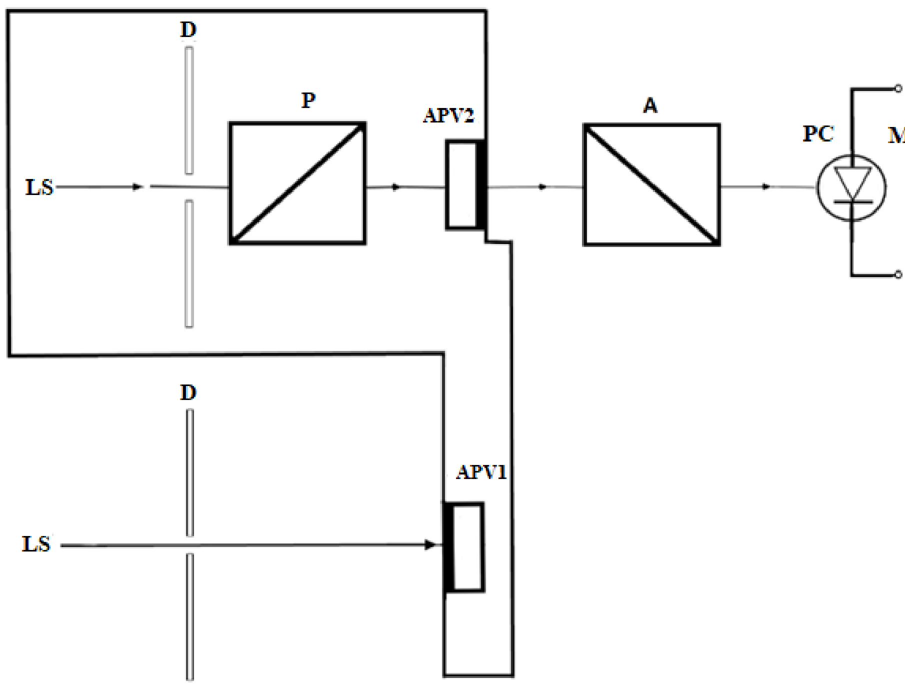


**Figure 3: Stand-alone non-volatile modulator.**

LS - Light Source; P - Polarizer; D - Diaphragm; A - Analyzer; APV - APV Film; PC - Photocell; MD - Measuring Device (Electrometer)

With these innovative applications of APV elements in optoelectronics, there is immense potential for advancing the field and developing more efficient and compact devices.

In conclusion, the utilization of APV elements in optoelectronics offers a pathway to usher in a new era of functional devices with advanced capabilities and compact form factors. As research and development in this field continue to progress, it is likely that we will witness the emergence of even more groundbreaking applications, ultimately revolutionizing the landscape of optoelectronic technology.

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