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Absorption coefficient of zinc phosphide on porous glass

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The transmission spectra of zinc phosphide on porous glass have been measured. The absorption coefficient of the zinc phosphide thin layer has been calculated.

1. Introduction

Porous glass is produced from sodium borosilicate glass by the leaching process. This material can be used as a substrate for production of elements in optics and optoelectronics [1]–[6]. In the past years, it has been shown that after impregnation of the glass with inorganic semiconductors a sharp absorption edge was obtained [7].

To obtain the porous glass, the sodium-borosilicate glass was heated at 950 K for the phase separation. During leaching in HCL and deionized water, the alkali-boron phase was leached and almost pure silica porous glass was obtained. The electron microscope micrographs show that the pores are interconnected. The diameters of the pores have been calculated using the absorption-desorption technique [6]. In the investigated glass the diameters of the pores amounted to 2–5 nm.

The thin layer of the zinc phosphide was obtained by thermal evaporation of the monocrystalline material in vacuum. After evaporation, the samples were heated at high temperature (950 K) during 2 h in the argon atmosphere.

The optical absorption was measured before and after baking in the wavelength range from 0.5 to 1.2 μm.

2. Results

The light transmission of the porous glass (Fig. 1, curve 1) is small because of the porosity of the glass. After deposition of zinc phosphide on the glass surface, the light transmission decreases about 30–40% (Fig. 1, curve 2). Baking of the sample causes the increase of the transmission almost to that observed for pure glass sample (Fig. 1, curve 3).

The transmission coefficient of the zinc phosphide can be obtained by comparing the transmission spectra of the pure glass with the spectra obtained for the glass covered by zinc phosphide.

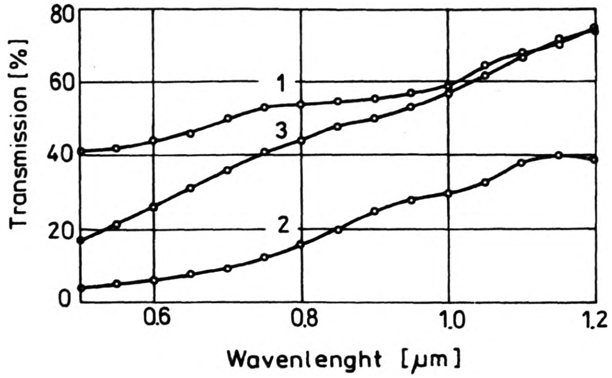

Fig. 1. Light transmission spectra for: 1 — porous glass without cover, 2 — porous glass with deposited zinc phosphide layer, 3 — porous glass with zinc phosphide after baking in 950 K in argon atmosphere

The best fitting (Fig. 2) of the absorption coefficient to the Fagen data [8] was received for the layer grown of 0.5 μm thickness and about 30% reflectance. For the layer after baking, in order to fulfill the best fitting conditions, almost zero value of the light reflection has been assumed and 0.2 μm thickness is obtained.

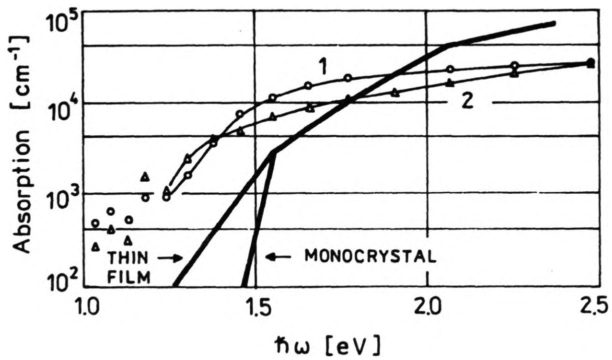

Fig. 2. Absorption coefficient spectra for: 1 — the deposited zinc phosphide layer, 2 — zinc phosphide layer after baking

For the absorption spectrum (Fig. 2, curves 1 and 2) of zinc phosphide deposited on the porous glass, there does not exist any sharp absorption edge observed for the monocrystal. Moreover, the spectra are smoother in comparison with the curves obtained for the polycrystalline thin films observed by other authors [7], [8].

The substrate influences essentially the optical properties of the layer. The mean thickness of the zinc phosphide layer is small and the layer has probably developed a three-dimensional structure. Due to the surface roughness a significant portion of the incident light is scattered inward the sample. The scattering effect for the extremely thin layer causes that the absorption edge is indefinite and difficult to determine. The light scattering is stronger after baking and the reflectance is absent. In this case, it is supposed that the zinc phosphide creates clusters of the sharp edges of the pores and the major part of the deposited layer has been evaporated outwards.

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