Using the impedance spectroscopy for investigation of aging, thermal and adsorption properties of glassy chalcogenide films

D. Tsiulyanu,[+] M. Ciobanu

Department of Physics, Technical University, bul. Dacia 41, MD-2060 Chisinau, Moldova,

[+] Author for correspondence: tsiudima@gmail.com

The work is dedicated to application of the method of impedance spectroscopy [1] to provide evidence and investigation of effects of aging, annealing, temperature and gas adsorption in chalcogenide based thin films. Briefly are described the peculiarities and unique properties of these materials, which determine their wide application in micro and optoelectronics, as well as the difficulties of their studying using traditional methods caused by samples structural disordering. The experiments have been provided with thin films of glassy quaternary composition $As_2Te_{13}Ge_8S_3$, synthesized in vacuum by melt-quenching method. The morphology and phase – structural state of the films was controlled by SEM and XRD methods, but impedance spectra were obtained using a HP4192A impedance analyzer. The measurements have been carried out in a large frequency range at different temperatures and environmental conditions, including either dry or wet air, as well as their mixtures with NO_2 or CO_2. It was found a high influence of aging on impeadance spectra of Pt - $As_2Te_{13}Ge_8S_3$ – Pt funcțional structures , which make evidence for presence of large spatial and compositional disordering [2]. This influence can be stabilized by sample's post preparation annealing. Effect of temperature on impedance spectra of previously aged (or annealed) chalcogenide films consists in variation of the both real and imaginary part of impedance, due to variation of frequency dependent both resistance and capacitance of the thin film devices. Moreover, all these electrical parameters appears to be very sensitive at adsorptive processes. The spectra plotted as the imaginary part versus real part of impedance (Nyquist diagrams), represents depressed semicircles with radius's that depend on nature and concentration of adsorpted species. Adsorbtion of nitrogen dioxade results in an esential and frequency dependent decreasing of ipedance parameters , which it is explaned by efective chemisorption processes due to interaction of "odd" electrons of NO_2 molecules with lone – pair electrons of chalcogen atoms. The effect of water vapor a contrary leads to a moderate increasing of impedance parameters that is explained by physisorption of H_2O dipoles with negative poles inward, resulting in localization of free holes at the surface[3]. The simple physical adsorption explains also the effect of carbon dioxide on impedance spectra. This effect is unessential, but it is reversible and clear observed even at room temperature.

***Keywords**: Chalcogenide films, Impedance, Aging , Annealing, Adsorption*

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