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Impact of Adsorbed Gases on the Transport Mechanisms in Ge8As2Te13S3 Amorphous Films

Abstract

It is shown that the gas adsorption in chalcogenide glasses results in modifications of transport mechanisms by the surface, along with formation of surface localized states. A detailed quantitative analysis is made on experimental data taking on glassy thin films of Ge8As2Te13S3, physically grown in vacuum. The measurements of alternating current (AC) conductivity of these films have been carried out in the frequency range from 5 Hz to 13 MHz, in both dry air and its mixture with a controlled concentration of nitrogen dioxide, at different temperatures. It was found that the changes of environmental conditions by applying of even very small (ppm) amounts of toxic gases, e.g. NO2, dramatically influences the AC conductivity spectra. This is due to a sharp increasing of holes concentration in the valence

band of an ultrathin layer adjacent to surface, which results in modification of the dominant mechanism of current flow. In a definite frequency range the charge transport by hopping via valence band edge localized states becomes negligible and the mechanism of conductivity via extended states becomes the main until frequencies $\omega > 105$ Hz, at which the mechanism of hopping via localized states in the vicinity of Fermi level becomes predominant.