Abstract Book

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Study of dielectric properties of some bulk Cu-As-Se-I chalcogenides

F. Skuban[a], S. R. Lukić-Petrović[a], M. V. Šiljegović[a], D. M. Petrović[a], M. Slankamenac[b]†
[a]*Faculty of Sciences, University of Novi Sad, Trg D. Obradovića 3, 21000 Novi sad, Serbia*
[b]*Faculty of Technical Sciences, University of Novi Sad, Trg D. Obradovića 6, 21000 Novi Sad, Serbia*

Corresponding author: fedor.skuban@df.uns.ac.rs

The impedance spectroscopy technique was used to study the frequency dependence of some dielectric parameters in the frequency range from 100 Hz to 1 MHz for the bulk amorphous semiconducting glasses from the system $Cu_x[(As_2Se_3)_{0.9}(AsI_3)_{0.1}]_{100-x}$at different temperatures (298–398 K). Values of the dielectric permittivity ε′ and dielectric loss ε″ were found to decrease with frequency and increase with temperature. The introduction of copper into the system increased the values of dielectric parameters. The results obtained are interpreted in terms of the Debye theory of molecular dipoles, and they indicate the existence of different types of dipoles that determine the mechanism of dielectric behavior of the investigated glasses. The dielectric permittivity of these compounds are explained by means of a model of the process of hopping over the potential barrier between localized sites and the maximum barrier height W_M were calculated.

Keywords: Chalcogenide glassess; Dielectric properties; Dielectric permittivity

High-conductive Cu_6PS_5I-based thin films: structural, electrical and optical properties

I. Studenyak[a], V. Izai[a], A. Bendak[a], P. Kúš[b*], S. Kökényesi[c]
[a]*Faculty of Physics, Uzhhorod National University, 3 Narodna Sq., 88000 Uzhhorod, Ukraine,*
[b]*Faculty of Mathematics, Physics and Informatics, Comenius University, Mlynska dolina, 84248 Bratislava, Slovakia,*
[c]*Faculty of Science and Technology, University of Debrecen, 18/a Bem Sq., 4026 Debrecen, Hungary*

Corresponding author: studenyak@dr.com; kus@fmph.uniba.sk; kiki@science.unideb.hu

Cu_6PS_5I crystals belong to a wide family of superionic conductors with argyrodite structure. Changing the bulk materials with thin-layer structures based on it is very important task. Such materials in thin-film form are more applicable for modern micro- and nanoelectronics from viewpoint of integrated semiconductors technology.

Cu_6PS_5I-based thin films were deposited using technique of non-reactive radiofrequency magnetron sputtering on the silicate glass substrates in Ar atmosphere. For sputtering we used the co-deposition technique from two tilted magnetrons – one equipped with Cu_6PS_5I target (pressed powder) and second with pure Cu target. Structural studies, performed using SEM technique, confirm the formation of a uniform two-dimensional structure. EDX spectroscopy was used to ensure the thin films chemical composition. At increase of copper content the increase of halogen content and decrease of phosphorous and sulphurare observed.

Electrical studies have shown that the total electric conductivity of the Cu_6PS_5I-based thin films increase with increase of Cu atoms content. The high value of electrical conductivity in thin films under investigation makes them the promising material for creation of solid state batteries and supercapacitors.

Optical transmission spectra of Cu_6PS_5I-based thin films were studied in the interval of temperatures 77–300 K. With Cu content increase, a red shift of the optical transmission spectra is observed. Optical absorption edge spectra of Cu_6PS_5I-based thin films have shown the exponential behaviour and their temperature variation are described by the Urbach rule. The temperature behaviour of the Urbach absorption edge in Cu_6PS_5I-based thin films is explained by electron-phonon interaction which is strong in the thin films under investigation.With Cu content increase the decrease of Urbach energy is observed that indicates on structure ordering in Cu-enriched Cu_6PS_5I-based thin films. The dispersion dependences of the refractive index for Cu_6PS_5I-based thin films were obtained from the interference transmission spectra.

Review of physical-chemical properties and applications of chalcopolythionic acids

V. J. Sukyte, L. Samardokas, R. Ivanauskas, A. Ivanauskas, I. Ancutiene
Faculty of Physical and Inorganic Chemistry, University of Technology,
LT-50254 Kaunas, Radvilenu str. 19, Lithuania

Corresponing author: vida.sukyte@ktu.lt

Free, unsolvated chalcopolythionic acids had not been prepared until quite recently: V.Zelionkaite and J.Sukyte in 1970 – 1972 announced the solvent - free synthesis of selenotrithionic $H_2SeS_2O_6$, diselenotetrathionic $H_2Se_2S_2O_6$ and monoselenopentathionic acid $H_2SeS_4O_6$ [1]. These acids were isolated from their potassium or barium salts [1-2]. The last chalcopolythionic acid – free monotelluropentathionic acid $H_2TeS_4O_6$ had been prepared only in 2004 [3, 7].

Chalcopolythionic acids are yellow or faintly yellow liquids. Only the hexahydrate of selenopentathionic acid $H_2SeS_4O_6\ 6H_2O$ which occurs in 3.8 – 4.0 M solutions of selenopentathionic acid at low – temperature - 78° is faintly yellow needled crystals, melting and decomposing at 0° - 3° [1, 2].Some chemical – physical properties of chalcopolythionic acids like the kinetics of the decomposition, density, refraction, specific and equivalent conductivity, and optical properties were determined [1, 6, 7]. It was shown, that isolated acids are strong, diprotic acids [1, 6]. Metal chalcogenides semi – conducting materials have found many applications in opto – electronic, solar cell and photovoltaic devices. There have been a wide variety of techniques for the formation thin layers of copper chalcogenides on various dielectrics, and on the polymers and glass too. There is presently great interest in the development of low – cost and simple processing methods. The sorption – diffusion process has been developed for the formation of copper and cadmium chalcogenides layers on the polycaproamide PA using those new molecular precursors – chalcopolythionic acids as single source for chalcogens – S, Se and Te [4, 5, 8, 9].

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