physical properties of amordhous semiconductora (BULK AND FILMS)

mostafa ibrahim guda

A method which has been recently used to correlate the structure and properties of various types of chalcogenide glasses is the chemical bond approach. It can be successfuly used to rationalize the observed properties of these materials, as well as to predict criteria forselecting materials with desirable properties.In the present study the system Se Ge Te was chosen. The energies of chemical bonds expected to be present in the system have been estimated. The cohesive energy, CE, of different compositions was calculated. Three compositions of high values of CE were prepared in such a way that all heteropolar bonds are satisfied. The chosen compositions have the general formula Sec) Ge60, Te. where x = 23.33 , 26.67 and 30X-ray diffraction patterns indicate that all prepared samples at room temperature have amorphous structure. Diferential ThermalAnalysis D.T.A. technique reveals that Tg, Tc and Tm are depending on the composition of the glasses as well as values of cohesive energies CE.D.c conductivity, a of all prepared samples were measured as a function of ambient temperature, T. Often the relation between In a and 1/T could be divided into two parts separated by a kink at temperature T*, which reveal that there is more than one conduction mechanism. The observed trend has been accounted for in terms of Mott and Davis model. The variations in activation energies, 6E, and the pre-Abstractrexponential factor were interpreted in terms of cohesive energies of the investigated compositions.The I - V characteristics for bulk samples of different thicknesses under high applied fields, has been studied at various ambient temperatures. All samples showed switching with memory characteristics. The experimental data have been analyzed in the light of existing theoretical models. The electronic model fails to explain all the observed switching phenomenon. The electrothermal model is most appropriate for explaining the switching mechansim observed in the investigated samples.Frequency and temperature dependence of a.c conductivity,a (o.) dielectric constant s’ and dielectric loss s” are also studied . The measurments are made in the frequency range (50 Hz-100 KHz) and in the temperature range 353-473 k . The obtained data were used to estimate the exponent s from the relation a (co) = Mos , where A is a constant and o.) is the angular frequency. The exponent s was found to decrease linearly as the temperature increases. The observed trend has been accounted for in terms of pair Correlated Barrier Hopping mechanism CBH.A detailed analysis showed that the dielectric losses are dipolar in nature and can be understood by assuming charge cariers hopping over a potential barrier, first . suggested by Elliott

for the case of chalcogenide glasses.The prepared (bulk) samples were used to prepare thin films of different thicknesses by thermal evaporation under vacuum techniqe. X-ray diffraction patterns indicate that all prepared films at room temperature had amorphous structure.Measurements of the voltage - dependence of current werecarried out for various ambient temperatures and for different thicknesses. All films showed switching with memory characteristics. The results obtained showed that for high fields a non-linear dependence exist . The currents in this region have been interpreted as space charge-limited currents due to the presence of trap levels in the forbidden band (Poole- Frenkel effect).Reflectivity R and transimissivity T of prepared films were measured in the spectral range (185-2500nm). R and T were utilized to estimatethe opitcal gap Eapt and the corresponding band tail width Ec . The absorption coefficient (a) was also determined Analysis of the absorption spectrum reveals indirect optical transitions.The optical constants, refractive index (n) and extinction coefficient k were determined using ellipsometric technique, in addition to the real and imaginary parts of dielectric constant (e*, e”).