ABSTRACT

The research programme involves fabrication of glasses containing cadmium sulphoselenide and investigation of the effect of heat treatment of the glass on the generation of colour.

Coloured cadmium sulphoselenide glasses were fabricated by quench cooling molten sodium silicate glass containing the appropriate colourants CdS and Se and the reducing agents ZnO and Sn. The selection of the batch charging, melting, stirring and quenching procedures involved several trials to determine the final conditions which allowed most of the colourants to be retained in the glass melt.

The glass transition temperature was determined for the fabricated samples enabling the selection of a suitable striking temperature. This was followed by the heat treatment of the various samples at 640°C for different durations from 0.5 hr. to 16 hrs. to develop and study the colour in the glass. The optical absorption spectra of these samples showed an initial shift of the absorption cut-off of the glass towards longer wavelengths till 2 hrs. of heating which was thereafter followed by a continuous shift towards shorter wavelengths.

The theoretical study of the observed phenomena prompted the synthesis of CdS_xSe_{1-x} thin films using the reportedly successful and easy solution deposition technique. An analysis of the optical absorption spectra of the thin films prepared using this technique showed the films to be a mixture of CdS and CdSe, hence no compounds of the type CdS_xSe_{1-x} could be synthesised by this method. This was followed by the measurement of the particle sizes of the CdS_xSe_{1-x} microcrystallites in the glass from the micrographs as well as the analysis of their diffraction patterns, both of which were obtained using the Transmission Electron Microscope. The mean particle sizes of the CdS_xSe_{1-x} microcrystallites in the glass were found to increase with the increase in heating time. Moreover, these microcrystallites showed a constant composition all throughout within allowable error limits, discounting any explanation on the basis of a compositional change.

The measured particle radii were used in Mie's theory, which takes into account the effects of optical absorption as well as scattering due to the microcrystallites in the glass. The dependence of the dielectric parameter (ε_2) on the size of the microcrystallites, as proposed by Kawabata and Kubo, was used to modify the theory. Additional modifications were necessary to consider the effect of lattice disorders in polycrystalline semiconductors as stated

by Mott. The optical density vs. wavelength plots, thus obtained, were in close correspondence with the experimental plots, thereby lending credence to the theory.

Key Words: Cadmium sulphoselenide, Melting, Fabrication, Colourants, Striking temperature, Heat treatment, Absorption, Scattering, Absorption Cut-off, Thin films, Particle size, Composition, Dielectric parameter, Polycrystalline, Optical density.