CHARACTERISATION OF OPTICAL PARAMETERS OF ZINC SULPHIDE AND SILVER METAL FILM COATED ON GLASS AT DIFFERENT DEPOSITION ANGLES

Abstract

The greatest challenge of smart window technologies is the regulation of heat accumulation indoors through fenestration and at the same time have a good visibility. Therefore, the spectral characteristics of thermally evaporated Zinc Sulphide (ZnS)/Silver (Ag) nanostructured coatings have been studied by varying the film thickness and deposition angle. Film thickness ranged between 4 nm to 15 nm. The deposition angle ranged between 0^o to 60^o. The spectral properties of the samples was studied by the spectrophotometer with UV-WinLab software in the wavelength range of 250-2500. The transmittance of (4 nm)ZnS/Ag, (7 nm)ZnS/Ag, (10 nm)ZnS/Ag and (15 nm)ZnS/Ag samples in the visible region was 61.7%, 66.3%, 54.9%, and 18.0% respectively. The transmittance of the nanostructures increased with the increase in deposition angle of silver nanoparticles. The transmittance measured at 1800 nm wavelengths 2.8%, 21.7% and 22.1% respectively. The reflectance of normally deposited ZnS/Ag nano-films was relatively low (ranged between 5% - 35%) in the visible range of the electromagnetic (400-800 nm) followed by a rise in reflectance to about 54% towards the infrared at about $\lambda = 800$ nm. However, the reflectance decreased with decrease in film thickness and decreased with increase in deposition angle of silver nanoparticles. The reflectance of ZnS/Ag nanostructures decreased with increase in deposition angle of zinc sulphide. The transmittance decreased with increase in film thickness and increased with increase in deposition angle silver nano-films. The transmittance in the infrared region increased with increase in deposition angle of zinc sulphide. However, the deposition angle of zinc sulphide had minimal impact on optical transmittance in the visible spectrum. The effective refractive index increased from 3.25 the visible spectrum to 6.2 in the infrared spectrum. The low values of effective refractive index in the visible wavelengths indicates that the nano-films are transparent to visible light. The increase in the value of effective refractive index in the infrared region and decrease in effective extinction coefficient at the absorption edge could be explained by high optical absorption. The increase in the value of effective refractive index in the infrared region and decrease in effective extinction coefficient at the absorption edge could be explained by high optical absorption. The extinction coefficient increased from an average 0.2 at $\lambda = 400$nm toward the infrared spectral range. The increase in the effective extinction coefficient with deposition angle indicates that the light travelling through ZnS/Ag nano-films experiences attenuation due to loss of energy. The increase in deposition of ZnS did not significantly affect the energy band gap. However, the increase in deposition angle of silver increased the energy band of the nano-films from 3.52 to 3.99 eV.