Chemically deposited CuS and $Cu_{2-x}Se$ coatings in the production of spectrally selective laminated solar control glazings

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Application of chemically deposited semiconductor thin films as solar control coatings has been proposed in 1989 [1]. In particular, CuS thin film has been found to possess "near-ideal" solar control characteristics [2], with its optical transmittance peak located near 565 nm, which corresponds to the sensitivity maximum of human eye for daylight vision. The origin of the transmittance peak in the case of chemically deposited CuS as well as in that of $Cu_{2-x}Se$ thin films [3] is the high electrical conductivity, about $5x10^3$ ohm^{-1} cm^{-1}. This causes high optical reflectance, which increases from 20-30% in the red-end of the visible region to nearly 80% at 2500 nm - the long wavelength end of terrestrial solar radiation. Along with the optical absorption due to free carriers and charge carrier generation across the band-gap, an inverted asymmetric bell-type transmission curve is produced for these degenerate semiconductor thin films.

Since application in architectural windows calls for the development of large area coatings, batch production of these films on appropriate substrates is essential. The optimization of the deposition geometry for maximum thin film yield suggests that film thickness of 50 nm to 100 nm for CuS and $Cu_{2-x}Se$ coatings, as required for architectural window applications are achieved at substrate separation of 0.1 to 1 mm. The thin film yield in such cases approaches 100% [4].

Taking into consideration that solar control coatings in architectural windows must provide long durability, in excess of 25 years, the production of laminated solar control coating was proposed [5]. This involves the deposition of CuS or Bi_2S_3-CuS or ZnS-CuS thin films on glass substrates and laminating them in the configuration: glass+coating/PVB or EVA/glass, in the temperature range of 120ºC – 140 ºC for 30 min and at a pressure of 2 kg/cm^2 to 15kg/cm^2, depending on whether the laminating polymer sheet is polyvinyl butyral (PVB) or polyethylene vinyl acetate (EVA).

An alternative to depositing the film directly on a glass substrate is depositing it on sheets of polyester (polyethylene terephthalate – PET) and assembling it into glass/PVB or EVA/Coated PET/PVB or EVA/glass for lamination. Here roll-to-roll production of the coated PET may be considered.

In this paper we would present an overview of the problems and prospects of developing laminated solar control coatings using chemically deposited thin films. Issues related to batch-production, optical characteristics, and the evaluation of adhesion of the coatings in the laminated glass assembly, impact-resistance, solar radiation rejection factor, etc., will be addressed.

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