Determination of average refractive index of thin CeO_2 films with large inhomogeneities

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Abstract
Thin films of cerium dioxide were deposited on heated (HS-films) and unheated (US-films) substrates by electron-beam evaporation. An attempt was made to determine their refractive indices from the measurement of their transmittance at normal incidence. All films were found to be optically inhomogeneous (i.e. variation of the refractive index along the depth of the film). The degree of inhomogeneity in the HS-films was far greater than that in the US-films. It is known that films of cerium oxide (HS-films) are far more inhomogeneous than the films of some other metal oxides. Satisfactory dispersion curves could be obtained for the US-films on the basis of a commonly used linear-index-variation-profile. However, in the case of HS-films satisfactory curves could not be obtained when such an index-variation-profile was used. On the other hand for the HS-films, satisfactory curves were obtained by the use of a quadratic-index-variation-profile. A simple model of a growth of film with columnar structure is proposed, for the first time, such as to justify the use of the quadratic-index-variation-profile in the case of a film with large inhomogeneity. The growth model needs to be verified physically by some other means.