A typical thin film of a high-index oxide coating material deposited by electron-beam (E-beam) evaporation has a refractive index lower than the bulk value for the material. This indicates that the film is porous, having a density less than the bulk density. In addition, such films are often inhomogeneous, having a higher refractive index near the substrate surface. Thin films of the same materials deposited by ion beam sputter deposition (IBD) techniques tend to have higher and more uniform refractive indices, indicating that IBD films are denser and more homogeneous. We have measured the index of refraction n, the extinction coefficient k and the degree of inhomogeneity of several high-index oxide materials deposited by IBD and by standard E-beam evaporation. The materials investigated were the oxides of zirconium, tantalum, hafnium, niobium and aluminum. In all cases, the IBD films were found to have higher refractive indices than their evaporated counterparts. The IBD films, in general, exhibited an inhomogeneity which was the reverse of the inhomogeneity found in the E-beam films. This indicates a difference in the nucleation and growth of the films. Tantala films show an absorption band in the visible spectral region resulting from electron trapping sites. Thus, this material is probably not suitable for coatings for visible and UV laser systems.

Keywords: absorption, Al, 2, O, 3, electron beam evaporation, HfO, 2, inhomogeneity ion beam sputter deposition, Nb, 2, O, 5, refractive index, Ta, 2, O, 5, ZrO, 2

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oxide films prepared by ion-beam sputter deposition (IBSD) [3], the oxygen partial pressure. () can affect their deposition rates, optical properties, and surface morphologies. Depositing at each optimal. Figure 1 shows schematic drawing of the ion beam sputtering system for this study. The system with a Kaufmann type ion source manufactured by Veeco Inc. was equipped with 3 cm diameter molybdenum grids. A target mounted on a water-cooled copper block was pure zinc metal (99.99%) slab with a size of 12 × 10 × 1 cm. described the optical band gap as the minimum energy needed to excite an electron from the valence band to the conduction band. Sputter deposition is a physical vapor deposition (PVD) method of thin film deposition by sputtering. This involves ejecting material from a "target" that is a source onto a "substrate" such as a silicon wafer. Resputtering is re-emission of the deposited material during the deposition process by ion or atom bombardment. Sputtered atoms ejected from the target have a wide energy distribution, typically up to tens of eV (100,000 K). The sputtered ions typically only a small fraction of the ejected