Characterization of ZrO_2 thin films deposited by MOCVD as ceramic coatings

Torres-Huerta, A.M. , Domínguez-Crespo, M.A., Onofre-Bustamante, E., Flores-Vela, A.

Instituto Politécnico Nacional, CICATA- Altamira, Km 14.5, Carretera Tampico-Puerto Industrial Altamira, Altamira, Tamps 89600, Mexico

Abstract

Transparent cubic-, tetragonal-zirconia thin films were successfully deposited on glass and quartz substrates by using the metalorganic chemical deposition technique. The thin films were achieved by adjusting deposition parameters such as substrate temperature, oxygen partial pressure, and zirconium acetylacetonate ($Zr(acac)_4$) used as precursor. Structural and morphological characterizations of the as-deposited thin films were studied by XRD, Raman spectroscopy, SEM, and AFM techniques, while some optical properties such as transmittance and refractive index were determined by means of the UV-vis technique. The ZrO_2 films, grown at 700 °C and different $$ P-{{{\text{O}}-{ 2} }}{:}P-{{\text{Zr(acac)}-{4} }} $$ ratios, displayed very variable particle sizes ranging from ~0.2 to 1.0 μm, and crystallite sizes within 10-30 nm forming a uniform film. Low mean roughness was obtained in the samples, which varied from 0.674 to 1.33 nm. These films grew with a columnar structure and apparently with low carbon content (<0.2%). All the synthesized thin films showed an adequate optical transmission, but the most transparent (>80%) was obtained with a $$ P-{{{\text{O}}-{ 2} }} {:}P-{{\text{Zr(acac)}-{4} }} $$ ratio of (Pa) 107:0.2. The oxygen partial pressure influences the crystallinity of the as-deposited films, while the refractive index remains constant. © 2011 Springer Science+Business Media, LLC.

Journal of Materials Science

Volume 47, Issue 5, March 2012, Pages 2300-2309