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Influence of plasma parameters on the characteristics of ZrO₂ and ZrSiO₄ thin films obtained by PECVD in low pressure plasmaInes Martinko¹, Jérôme Cornil², Salah Sahli³, Rony Snyders⁴, Olivier Antonin⁵,
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Zirconium dioxide coatings are of interest to variety of applications in areas ranging from microelectronic industry and optical devices to biomedicine and protective coatings. These applications are based on its desirable properties such as the high refractive index, high transparency for visible and near infrared light, wide band gap, high dielectric constant, hardness, oxidation resistance, etc.

In this work zirconia and zirconia-silica thin films were synthesized by PECVD in Electron Cyclotron Resonance (ECR) microwave plasma. Zirconium Tetra tert-Butoxide (ZTB, C₁₆H₃₆O₄Zr) and Hexamethyldisiloxane (HMDSO, C₆H₁₈OSi₂) were used as precursors and oxygen was used as an oxidant gas. To study the correlation between the plasma phase and thin film growth, the investigation of the plasma phase by means of OES, FTIR and MS was coupled with thin film examination by FTIR, XPS and SEM.

Characteristics of the deposited thin films can be tuned by varying plasma parameters such as the amount of oxidant gas. By increasing the amount of oxygen in the ZTB/O₂ gas mixture the deposited ZrO_xC_yH_z films evolve from organic to inorganic. At ≥80% of oxygen present in the gas mixture the deposited films exhibit high refractive index, good transparency and high hardness. At the same time the morphology of the films is columnar which leads to low barrier properties.

In order to resolve the columnar growth different amounts of HMDSO were added to the gas mixture. As a result the properties of deposited thin films have been modified. New composite films obtained from ZTB/HMDSO/O₂ plasma were examined in the interest of obtaining thin films with good barrier properties as well as good optical and mechanical characteristics.

Keywords

PECVD

Zirconia thin films

Zirconia-silica thin films

ECR microwave plasma