MOD ceramic CeO2 films on (001)-YSZ substrates

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Abstract

The growth mechanism of high quality 7-80 nm thick CeO2 nanometric epitaxial films, deposited on (001)-YSZ from 2,4-pentadionate solutions, has been investigated . XRD patterns typically reveal only the occurrence of the (00l) orientation and an excellent, thickness dependent, both off-plane and in-plane epitaxial qualities. Dw lies between 0.1° and 0.28° for the thickest film (80 nm). Diffraction averaged residual stresses determined using the sin2y method, reveal that the residual stress is effectively relieved as the thickness is increased. The surface of the films is typically granular, as revealed by AFM observations. Cross section TEM indicate also an in-depth granular structure which contrasts with the columnar microstructure typically reported for films deposited by vacuum techniques . The temperature dependence of the in-plain grain size was investigated for 30 nm thick films annealed at 650°C, 750°C, 800°C, 900°C and 1300°C, by quantitative analysis of AFM images. As the processing temperature increases the mean grain size increases while the size distribution becomes wider, baring witness of a secondary grain growth mechanism which typically occurs at high temperatures where grain boundary mobility is high. The observed temperature dependence of the grain size obeys an Arrhenius type behaviour, indicative of a thermally activated process driven by the motion of the grain boundaries, typically observed in 3D systems. Rms roughness values for films processed at 750°C in Ar/5%H2 lie within 1nm 2nm.The film roughness was further decreased down to a rms value of 0.6 nm by annealing at 1000°C in air. Acknowledgements This work has been partially financed by the EU within the scope of the Solsulet project, contract No. G5RD-CT2001-00550.