On the Ionic Conductivity of YSZ – CeO_2 Hetero-Interfaces

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A topic of intense and growing interest is the investigation of the ionic conducting properties of oxide film hetero-structures. Experimental evidence has been reported showing that interfacial phenomena arising from the strain field at hetero-phase interfaces give rise to faster ion conduction pathways than the bulk or homo-phase interfaces.[1-6] Nonetheless, a deeper understanding of the interface transport properties is still needed to exploit these effects.

In this work we have investigated the growth mechanism, the microstructural characteristics and the conducting properties of epitaxial hetero-structures and superlattices fabricated by pulsed laser deposition (PLD) coupling 8mol% Y_2O_3 stabilized ZrO_2 (YSZ) and CeO_2. Single crystalline MgO wafers were selected as deposition substrates. Biaxially textured hetero-structures were obtained by means of a thin buffer layer of $SrTiO_3$ (STO). The conducting properties of several hetero-structures with same thickness and increasing number of hetero-interfaces (from 4, up to 30) were measured and compared.

The growth mechanism was investigated, in-situ, by reflection high energy electron diffraction (RHEED). The microstructural characterization was performed by X-ray diffraction (XRD) and high resolution transmission electron microscopy (HRTEM).

The fabricated hetero-structures showed high crystalline quality and relatively low average dislocation density allowing the evaluation of the effect of the interfacial strain field on the conduction mechanism reducing the contributions potentially arising from grain boundaries and/or lattice defects. Electrochemical impedance spectroscopy (EIS) showed that for these samples the crystalline strain has negligible effect on the interfacial oxygen-ion conductivity.

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