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Ionic and electrochemical phenomena induced by structural and chemical defects in oxide thin films

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Interactions at the surfaces/interfaces between complex oxides and gaseous environment are fundamental for the efficiency of many environmental friendly systems and applications. Such interactions can be modified by the intricate interrelationship between microstructure and chemical substitution defects, being their role on functional properties, such as ionic conductivity and surface reaction rates, as particularly relevant as difficult to discriminate. New possibilities in thin film fabrication allow growth of oxide thin films with a more precise control of the structure and chemical stoichiometry, thus unveiling new perspectives in the study of electrochemical effects for physical functionalities, through nanoscale characterizations by complementary state-of-art techniques. As an example of interfacial structural defect effects, we will discuss the case of yttrium doped barium zirconate thin films, where the cation substitutions represent a viable mechanism, alternative to the formation of dislocations near the interface, to relieve the strain building up in the film growing on a highly mismatched substrate, thus providing fast transport pathways together with enhanced interface electrochemical reactivity. The effect of the chemical defects will be further presented in the case of samarium-doped ceria films with different doping concentration. We will explain the role of the trivalent doping on the conduction mechanism, i.e. proton or oxygen ion, which in turns may greatly influence the surface reactivity.