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"X-ray characterization of ultra thin free-standing doped ceria membrane for green hydrogen"

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Samarium and Gadolinium Doped ceria (SDC-GDC) is one of most promising material for energy conversion and storage. Indeed, CGO is a promising candidate as electrolyte for Solid Oxide Fuel cells (SOFCs) due to its high ionic conductivity. Even more, Ceria-based materials represent a very promising class of electrocatalysts for CO2 reduction in solid oxide electrolysis cells (SOECs) due to their higher stability and efficiency to convert CO2 in CO compared to other Ni-based material [1-2]. Epitaxial SDC thin films synthesized by Pulsed lased deposition (PLD) are deposited onto single crystal SrTiO3 (STO) perovskite substrates. STO substrate not only provide an "ideal"surface atomically flat for epitaxial thin film with low degree of defects but also, it can induce epitaxial strain by lattice mismatch between substrate and film generating a significant variation of the ionic and the transport properties. On the other hand, the commercial application of "devices" based on epitaxial oxides thin films deposited onto single crystal substrates is not convenient due to the high cost of the substrates and the difficulty to integrate in standard chips Silicon based, specially for material for electrochemical devices such as doped ceria that the ionic charge carriers increase the mobility in the temperature range higher than 200℃. For these reasons we need to combine the advantage to deposit films onto single oxide crystal substrate and the possibility to transfer the film on more engineered substrate that can be integrated smart devices. In this work we show the growth mechanism and the structural properties of epitaxial CGO buffered with selective etching of Sr3Al2O6 (SAO) as a hygroscopic oxide sacrificial thin film layer: heterostructure consisting of SDC layer and water-soluble SAO onto perovskite STO single crystal substrate is deposited by PLD, transferred to flexible substrate and finally, transferred onto conductive Si substrates [3]. Thanks to the sacrificial layer SAO we can transfer the CGO film deposited STO single crystal substrate with standard procedure by PLD opening new perspectives for industrial production based on oxide thin films combined with silicon micromachining technologies for new class of SOFC and SOEC devices. [1] Theis L. Skafte et al, Nature Energy 4 (2019), 846-855 [2] Sanna et al, Nature Materials 14 (2015), 500-504 [3] Di Lu et al, Nature Materials 15 (2016) 1255-1260

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