Modification of mixed conducting oxide surfaces with platinum nanoparticles and their electrochemical properties investigated by impedance spectroscopy

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In the search of high performance intermediate temperature solid oxide fuel cells (SOFCs), improving the kinetics of oxygen reduction on mixed ionic electronic conducting (MIEC) oxide surface is of great interest. Previous studies on $La_{0.6}Sr_{0.4}FeO_{3-\delta}$ revealed much higher water-splitting activity after cathodic polarization and subsequent exsolution of iron(0) particles on the surface. [1] Additionally, improved anode performance by exsolution of Fe-Ni nanoparticles on Ni-substituted $Sr(Ti,Fe)O_3$ anodes is reported in literature. [2]

In this study, the effect of surface decoration on mixed ion electron conducting materials with Platinum nanoparticles was studied. Symmetrical thin film samples of $Gd_{0.1}Ce_{0.9}O_{2-\delta}$ (GDC10), $SrTi_{0.7}Fe_{0.3}O_{3-\delta}$ (STF73) and $La_{0.6}Sr_{0.4}FeO_{3-\delta}$ (LSF64) were prepared by pulsed laser deposition on yttria-stabilized zirconia single crystals and characterized before and after platinum deposition at 600 °C in different atmospheres by electrochemical impedance spectroscopy.

First measurements show up to two orders of magnitude lower polarization resistance after surface decoration with Platinum particles. Furthermore, results indicate that nanoparticle decoration changes the rate-limiting step for oxygen incorporation. Morphologic studies on the nanoparticles were conducted using atomic force microscopy (AFM) and scanning electron microscopy (SEM).

[1] Opitz, A. et al., (2014), Angewandte Chemie Int. Ed.,54: 2628-2632

[2] Zhu et al., (2018), Joule 2, Elsevier Inc., 478-496