**In Situ Impedance Analysis of LSC Thin Films during Growth on YSZ and LSGM**

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**Introduction**

The mixed ionic electronic conducting perovskite oxide $\text{La}_{0.2}\text{Sr}_{0.8}\text{CoO}_4$ (LSC) is a very promising cathode material for application in solid oxide fuel cells (SOFC) due to its catalytic properties for the oxygen surface exchange and high electronic conductivity. A factor which is essential to consider in the characterization of LSC is the influence of lattice strain on the surface exchange resistance and the chemical capacitance.

Recent findings showed that tensile strained films exhibit faster surface exchange reaction and oxygen diffusion compared to compressively strained films. In this study, the influence of the two different substrates $\text{Y}_2\text{O}_3$-$\text{ZrO}_2$ (YSZ) and $\text{La}_0.5\text{Sr}_0.5\text{Ga}_0.5\text{Mg}_0.5\text{O}_3$ (LSGM) on LSC thin films was examined with a novel method allowing in situ impedance spectroscopy during the PLD process (IPLD). Thus, it is possible to track charge carrier densities during growth and to link results with microstructure and strain.

**Experimental I**

**Experimental II**

**Typical Impedance Spectra**

The typical impedance spectra feature three individual arcs in different frequency regimes:
- Current Collector (CC) – HF
- Working Electrode (WE) – MF
- Counter Electrode (CE) – LF

**Capacitance on Different Substrates**

An increase in the chemical capacitance of a factor 1.6 was found for tensile strained LSC thin films grown on LSGM compared to films grown on YSZ single crystals.

**Conclusions**

- Simultaneous PLD thin film growth and electrochemical characterization of LSC thin film electrodes
- Very high reproducibility of measurements
- Enhancement of the oxygen exchange kinetics by a factor of 2 for strained LSC films on LSGM compared to unstrained films on YSZ.
- Higher chemical capacitance in tensile strained films, suggesting a decrease of the oxygen vacancy formation energy leading to higher oxygen vacancy concentrations.

**Resistive Properties**

A lower oxygen exchange resistance of 1.04 ± 0.02 Ohm cm$^2$ is reproducibly found for LSC on LSGM measured at 600 °C and 40 µbar $\text{O}_2$. This indicates enhancement of the oxygen exchange kinetics by a factor of ~2 for LSC films on LSGM compared to films on YSZ.

**References**


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