

# Protective coatings for Solid Oxide Cell (SOC) interconnect by ink jet printing

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**Introduction-** The Solid Oxide Fuel Cell (SOFC) is an efficient technology to directly convert chemical energy from fuels to electricity. SOFCs are composed of two porous electrodes (fuel side and oxygen side) separated by a solid electrolyte. In order to increase the capacity of the SOFCs, cells are connected in series. The component that separates the cells is called interconnect (IC), which acts as the electrical connection between single cells and distributes the fuel/air to the electrodes (Figure 1). Chromium-based alloys (CrFeY alloys) are used as the IC substrate to suppress breakaway corrosion and can offer a stable and long-lasting (>40'000 h) interconnect. At operating temperature, the chromium forms a passivating Cr oxide layer on the surface which acts as a barrier layer against Fe corrosion. However, the Cr oxide layer causes other problems. Cr oxide is volatile and forms gaseous species that diffuse to the electrodes and result in significant degradation of cell performance. This is known as "Cr-poisoning" of electrochemical performance (Figure 1). In order to overcome this issue, protective coatings are an established solution. The La-Sr-Mn oxide perovskite (LSM) has been chosen for the coating material because it meets the requirements (e.g. high electrical conductivity, compatible thermal expansion with other components, etc).

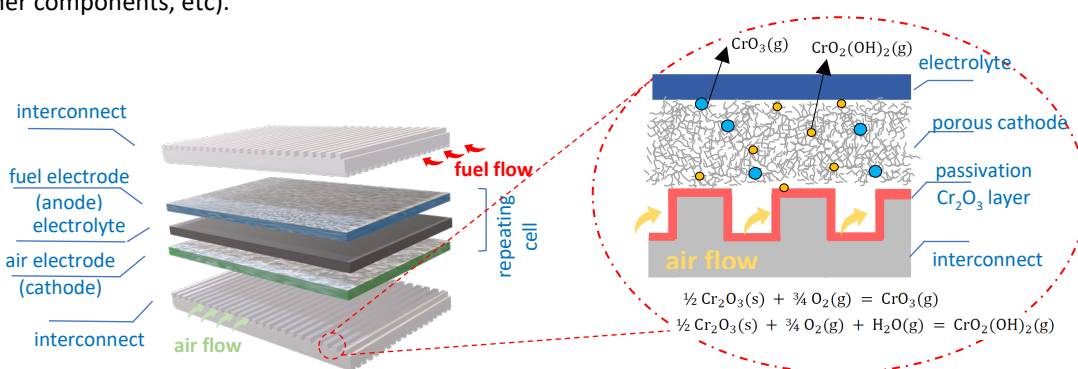


Figure 1. Schematic an SOFC components and the degradation of interconnects

**Current study-** Regarding the coating deposition technique, there are several methods. In the present study, the focus is to use inkjet printing (IJP) to deposit a protective coating layer on the SOFC interconnect substrate. IJP is of interest due to its high resolution, simple, contactless process and low material waste. A suitable LSM powder is available from a supplier. It needs thorough characterization using XRD, SEM, PSD, BET, and TGA. The bottleneck of inkjet printing is to avoid nozzle blocking due to particle agglomeration. Hence, the study focuses on the preparation of stable, well-dispersed, and agglomerate-free particle inks. To assess these properties, the stability, rheology, and surface tension of the ink should be characterized. The printable ink will be deposited on the interconnect steel substrates. Printing parameters such as jetting frequency, droplet formation, drop spacing, applied waveform, should be optimized. A post-treatment is required to vaporize the ink liquid and to achieve a uniform, dense, and good surface coverage of the printed layer. The morphology and the crystalline structure of the deposited coating will be analyzed.

**About the project** - The project is part of an EU-funded project, and the current study is in collaboration with an Swiss company active in SOFC. The powder characterization and ink formulation part can be done in the materials department, in the Powder Technology Group (PTG) at LMC. The inkjet printer is located on the EPFL Sion campus, Group of Energy Materials (GEM). The suggested time schedule is as follows: i) powder characterization: one month, ii) ink formulation: two months, iii) inkjet printing and characterization: two months, iv) analysis and writing: one month. The student will get help and training from from and PTG and will be supervised by Prof. Paul Bowen (head of PTG) and Dr. Jan Van herle (head of GEM). Interested students to perform a master thesis or semester project with materials science background are encouraged to contact: [samaneh.daviran@epfl.ch](mailto:samaneh.daviran@epfl.ch).

**Keywords:** SOFC; IC degradation; coating; LSM perovskite; inkjet printing; powder; surface characterization

**Reference** - Manuel Bianco, "Analysis of High Temperature Degradation of Alloys in Solid Oxide Fuel Cell," PhD Thesis (2018), EPFL.