Double-layered protective coating for Solid Oxide Cell (SOC) interconnect: using magnetron sputtering

(preferably for students with a background or interest in material science)
Contact: Samaneh Daviran, Samaneh.daviran@epfl.ch

Protective coatings have been extensively studied for 'air-side' interconnects to prevent high-temperature corrosion and Cr diffusion. Based on our previous study [1], spinels with AB_2O_4 structure, despite their semi-closed crystalline lattice, still allow Cr to diffuse through lattice. Hence, a novel double-layered coating configuration is being developed, where a thin inter-layer is applied between the substrate and the spinel, as shown in Figure 1a. This approach aims to prevent direct contact between the spinel and the substrate.

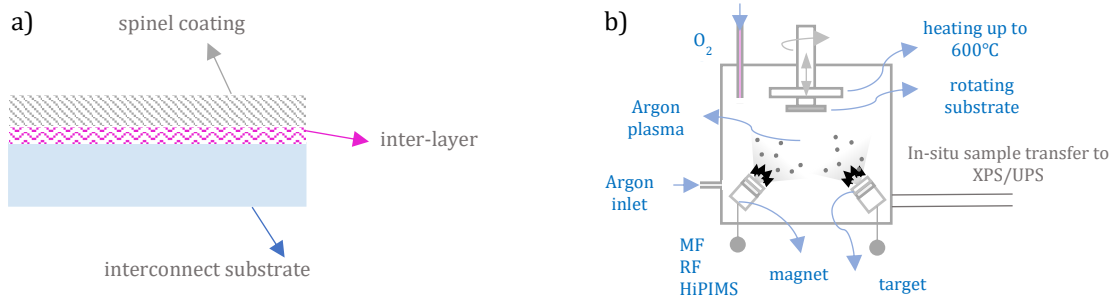

Figure 1. Schematics of a) double-layered protective coating, b) reactive magnetron co-sputtering

The properties of a coating are highly influenced by the deposition method, with various techniques offering distinct advantages and limitations. Magnetron sputtering is an advanced technique ideal for developing uniform, high-density protective coatings on SOC interconnects. In this process, plasma is generated in a vacuum chamber by applying a current to a target material, with inert or reactive gases like argon, oxygen, or nitrogen aiding the process (As shown in Figure 1b). Atoms ejected from the target material are deposited onto the substrate, growing a thin film. The efficiency and properties of the coating depend on factors like film density, grain morphology, and microstructure, all of which can be optimized by adjusting deposition parameters such as gas flow rate, chamber pressure, applied current, and substrate temperature. The goal of this study is to develop a double-layered coating for interconnects using magnetron sputtering (Figure 1a). The developed layers will be analyzed using SEM/EDX, XRD and XPS techniques.

This project will provide the student with an understanding of air-side interconnect degradation in SOCs and the methodologies for developing protective coatings using magnetron sputtering. The student will focus primarily on a literature review of interconnect degradation, material selection for the coating, and will receive training on magnetron sputtering in a laboratory at the Lausanne campus. The student will also be responsible for analyzing and interpreting the characterization results.

Reference

[1] S. Daviran, "Spinel Protective Coatings for Solid Oxide Cells (SOCs) Interconnects (ICs)", PhD Thesis, Group of Energy Materials (GEM), EPFL, 2024.