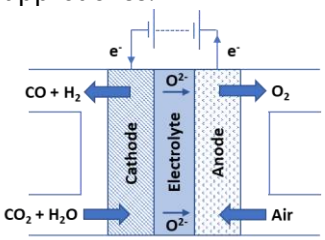
Overcoming challenges in solid oxides cells electrodes: stability and sustainability in perovskites

The development of novel materials to enhance the performance of solid oxide fuel and electrolysis cells is a prominent focus in materials science research. Perovskite oxides have shown significant potential, due to their mixed ionic-electronic conduction (MIEC) properties, making them suitable electrodes for solid oxide cells. The $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$ (BSCF) perovskite is a promising air-electrode exhibiting excellent oxygen reduction reaction (ORR) catalytic activity and good MIEC properties. Unfortunately, this material suffers from long-term stability issues, and it contains cobalt (Co), a toxic element with well-known supply issues. To advance research on this material, our group focused its efforts on two main approaches:

- Enhancing the stability of BSCF by incorporating Y^{3+} into its structure, which is reported to have a stabilizing effect.
- Developing a Co-free electrode derived from BSCF, by replacing Co with an optimized amount of Cu, while also stabilizing its structure with Y^{3+}.

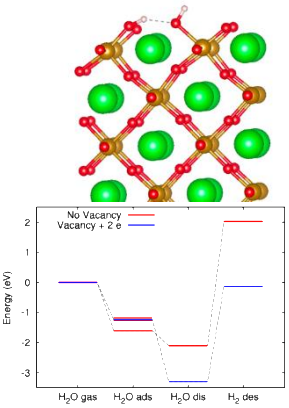
The results from various structural and electrochemical characterizations of the obtained systems will be presented during the lecture.



***Sara Massardo**, research fellow at CNR-ICMATE (Genoa-IT), MSc in Chemical Sciences, PhD in Sciences and Technologies of Chemistry and Materials. Her main research interests are related to the characterization of innovative materials for solid oxides cells using a variety of techniques (i.e., electrochemical impedance and μ-Raman spectroscopies, XRD, SEM, synchrotron light techniques).*

H_2O and CO_2 interaction with perovskitic (110) surface: the case of $SrFeO_3$

Understanding the reaction mechanisms and improving the reaction kinetics at the solid-gas interfaces of solid oxide cell electrodes have the potential to lower operational temperatures, thus hindering parasitic reactions that limit their stability and lifecycle, and expanding the range of materials that can be used in the cells. In general, reaction kinetics are influenced by thermodynamic quantities such as gas partial pressure and temperature, but they also strongly depend on the nature and availability of active sites. Electrode reactions further require charge transfer between adsorbed species and the solid electrode, meaning that the applied electric potential is another factor influencing overall kinetics. A detailed understanding of the oxide structure—especially of point defects, which may act as active sites at the solid-gas interface—and the adsorption energetics of reaction intermediates are essential for modeling electrode reactions and optimizing materials. This work presents first-principles results on the interaction of H_2O and CO_2 with the $SrFeO_3$(110) surface.



***Mario Italo Trioni,** researcher at CNR-SCITEC, bachelor's degree and Ph.D in Physics at the "Università degli Studi" of Milan-IT. His main research interests are related to theoretical ab-initio study of solid surfaces and molecule-surface interaction with focus on the magnetic, electronic, and electron transport properties. Other systems of interest are low dimensional carbon systems (graphene, nanoribbon and nanoflakes) and defective oxide surfaces.*

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19 February 2025 h 3:00-4:00 pm

Registration link