DTU Energy
Department of Energy Conversion and Storage

Protective coatings for interconnects of SOFC/SOEC stacks

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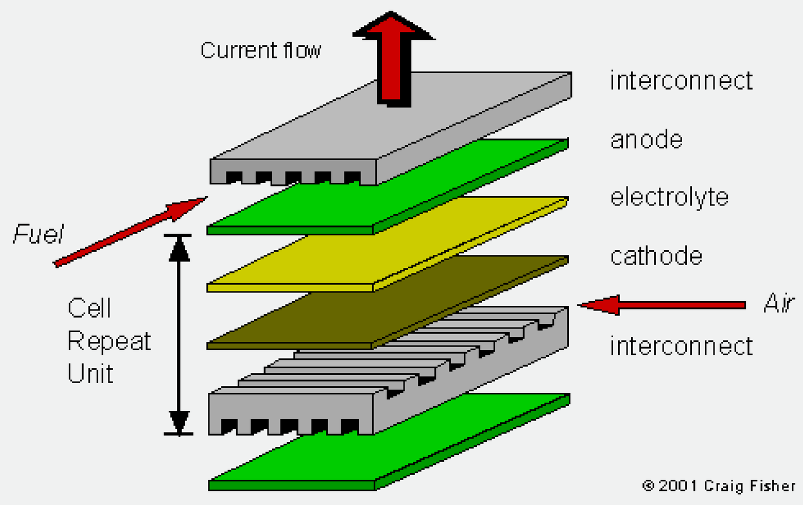
Solid Oxide Fuel/Electrolysis Technology

Role of the interconnect

Solid Oxide Fuel/Electrolysis stacks are composed of ceramic fuel cells and metallic separating elements: interconnects. They connect adjacent cells and allow for the current flow between neighbouring cells.



Succesful material for the interconnect must fulfil several requirements:

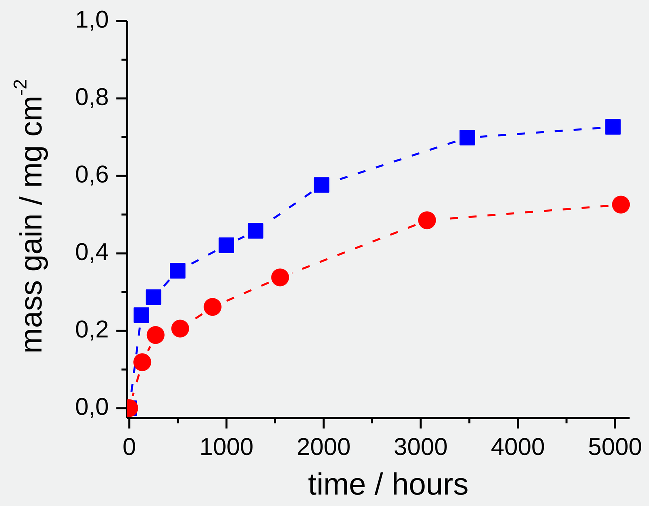
- Low electrical resistivity,
- Impermeability and stability to anode and cathode gases including thermal cycling
- Chemical compatibility with other cell components
- Close match in the coefficient of thermal expansion with other components
- Good mechanical properties, high thermal conductivity
- Ease of fabrication and low cost

Due to these specific requirements **stainless steels** found a broad use as modern interconnect materials.

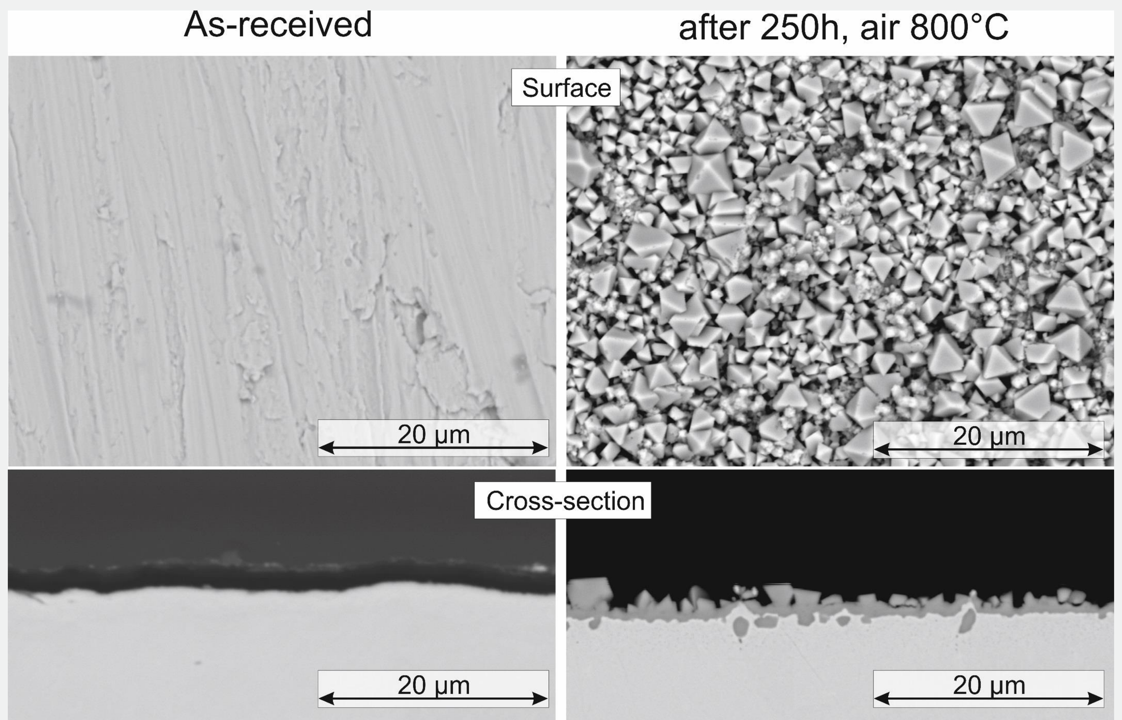
High temperature corrosion

Metallic materials exposed to high temperatures form an oxide scale on their surface. In case of steels used for fabrication of the interconnects (so called chromia formers), the oxide is usually a chromium oxide with a chromium-manganese spinel on top.

On a macroscopic level, corrosion processes can be described by mesuring the weight gain caused by the pick up of the oxygen (plots of weight gain at 850°C in air and oxygen for a coated steel are shown in the picture).



In order to characterize corrosion processes in details, samples are analyzed primarily by x-ray diffractometry (surface) and electron microscopy with elemental analysis (surface and cross section images).



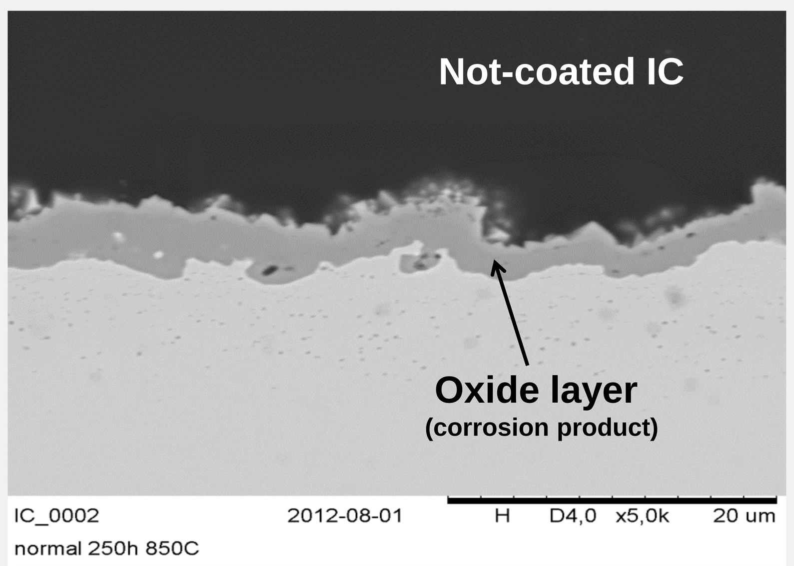
Research projects/activities:

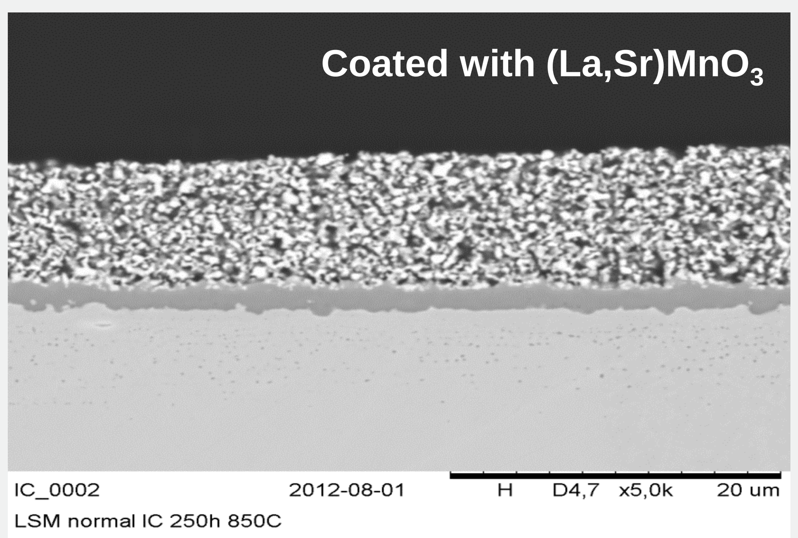
Protective coatings for the oxygen side

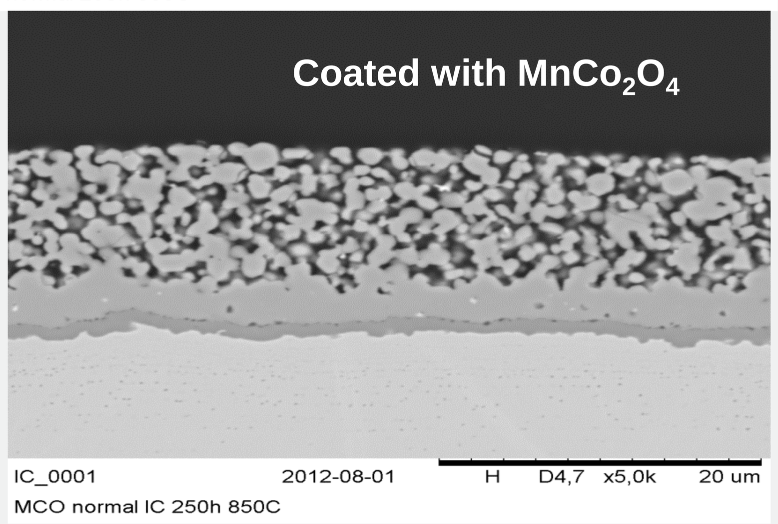
Corrosion studies concern the evaluation of interconnect materials (different alloys) at SOEC relevant atmospheres (H_2 with 50% steam, pure oxygen). Another activitiy is the development of protective coatings on full scale interconnects that will be tested in operating stacks. Coatings prolong the lifetime of steel by lowering corrosion rates.

Recent works focused on the electrophoretic deposition of different protective materials. By their use corrosion rates are lowered and chromium poisoning problems can be minimized.

Images show interconnects without and with two different coatings after 250 hours at 850°C.



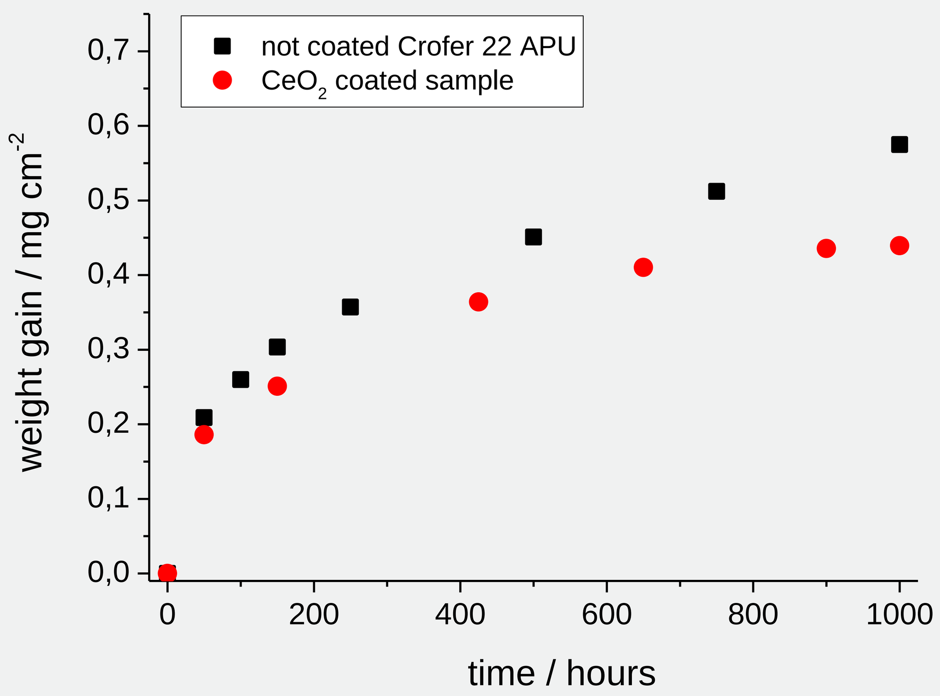


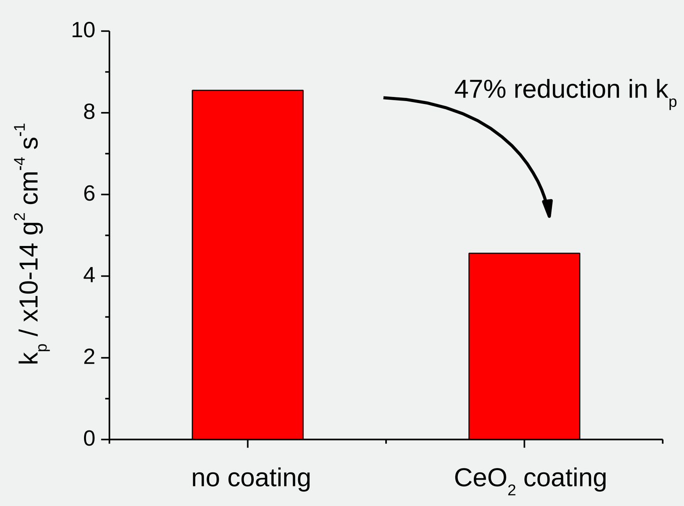


Protective coatings for the hydrogen side

Corrosion rates in hydrogen with high steam content are very similar to corrosion rates reported for air/oxygen. Therefore to ensure long term stable operation of a SOEC stack protective coatings for the hydrogen side should be found and applied.

This initial study has shown the usefulness of a thin ceria protective coating for lowering the corrosion rate of alloy used for SOEC interconnector. Weight gain smaller by 25% for modified sample is achieved.





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