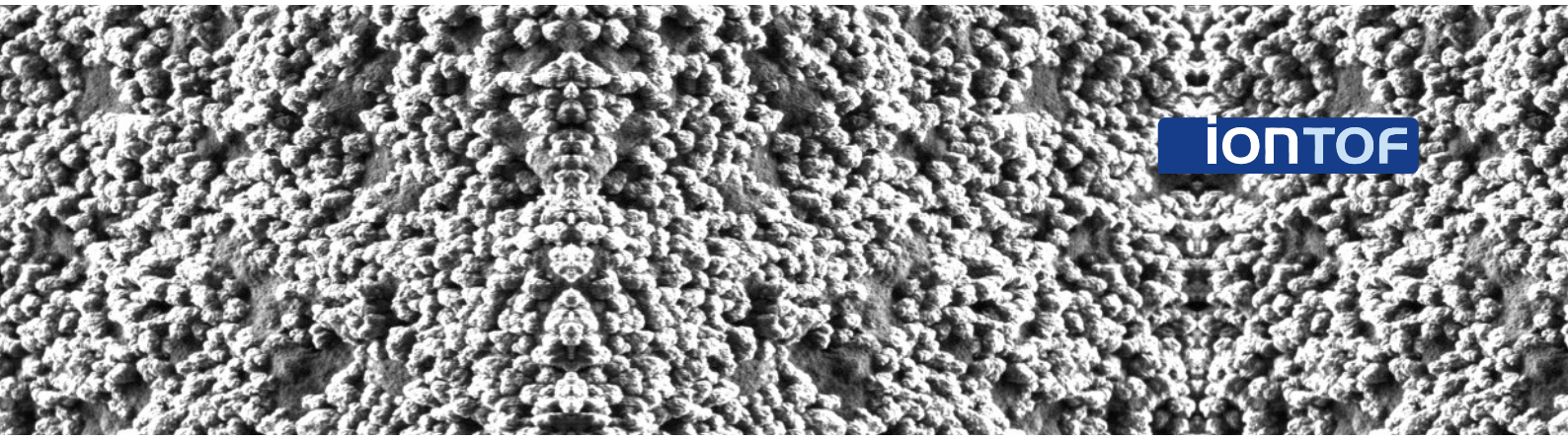

7 3

Solid Oxide Fuel Cell Materials

Elemental characterisation of the outermost atomic layer

Materials for Solid Oxide Fuel Cells (SOFCs) play an important role, e. g. for the oxygen reduction at the air electrode (cathode). The composition and structure of the surface determine the catalytic activity for this reaction. Low Energy Ion Scattering (LEIS) contributes unique information to the analysis of the outer surface.

In LEIS, the energy of an ion scattered from the surface is specific for the surface atom which was part of the scattering process. At the same time, neutralisation effects lead to a strong suppression of signal from deeper layers, resulting in distinct surface peaks. The peak positions identify the elements of the outermost atomic layer, while the intensity is directly proportional to the surface coverage. This allows a quantitative elemental characterisation of the outermost atomic layer – even on rough and insulating surfaces.

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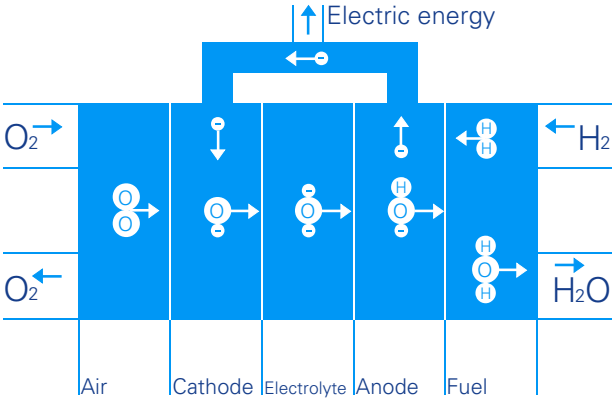
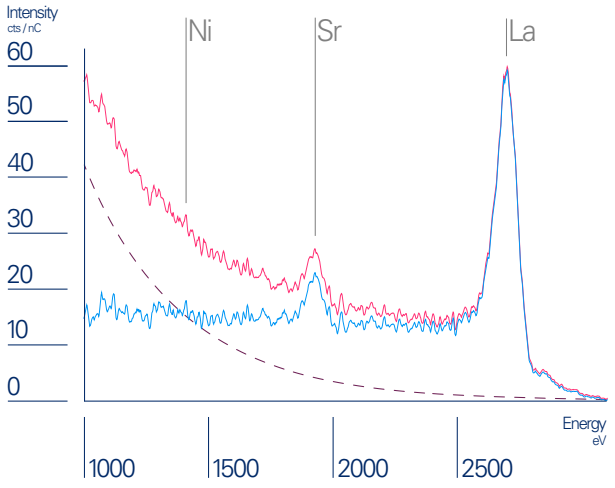
Analysing the outer surface of Sr doped La_2NiO_4 crystals

One candidate for the SOFC cathode material is Sr doped La_2NiO_4. To explain the catalytic activity, the surface composition is crucial and was analysed using LEIS.

The spectra of both as cleaved and heat treated low-index faces of a single crystal show no Ni surface peak, indicating a La/Sr oxide termination. This is in contrast to a NiO termination, as previously suggested by computational models. XPS and CRT data support this finding, although only LEIS has sufficient surface sensitivity to fully discriminate the outer surface from deeper layers.



Working principle of a solid oxide fuel cell, generating electrical energy directly from oxidising a fuel.



LEIS spectrum using Ne scattering of the (001) face of heat treated $La_{1.67}Sr_{0.33}NiO_4$[+].
The peaks for La and Sr and the absence of a Ni peak clearly show the surface composition. O is also present but not visible under these conditions.

For further details see:
Mónica Burriel et al., Energy Environ. Sci., 2014, 7, 311 (Figure adopted with permission of The Royal Society of Chemistry)