

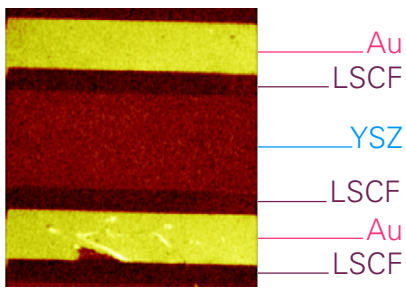
Patterned Samples

LEIS analysis of laterally structured surfaces

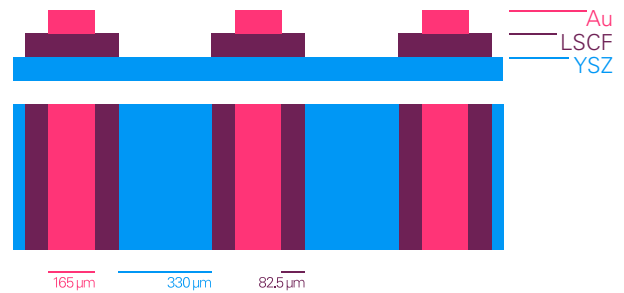
Traditionally, the samples analysed by Low Energy Ion Scattering (LEIS) are homogeneous and the surface composition is determined on the full field of view which is on the order of $1 \times 1 \text{ mm}^2$. The unique High Brightness Ion Source (HBIS) of the Qtac allows the beam to be focused to better than $5 \mu\text{m}$, which enables imaging and laterally resolved spectrometry measurements.

In LEIS, static analysis of the surface is mandatory to preserve the composition of the outermost atomic layer. Even more than on larger areas, detection sensitivity is key when working with a focused beam to analyse small areas.

In this study, a working fuel cell model structure with patterned electrodes was used to make the relevant surfaces accessible to the analysis. The LEIS image using 5 keV Ne scattering shows the excellent lateral resolution, which is essential for further treatment of the data. Subsequent to the measurement, regions of interest were determined to reconstruct the spectra from the three main features. In contrast to directly measuring the spectra on small areas, this method allows unambiguous assignment of the data to the different lateral features, even on irregularly patterned surfaces.



Total LEIS image of the fuel cell model structure. Field of view: 1 mm x 1 mm



Schematics of the electrode structure used in this study

The intense signal from the Au current collector can be successfully separated from the regions of greater analytical interest.

The $\text{La}_{0.6}\text{Sr}_{0.4}\text{Co}_{0.2}\text{Fe}_{0.8}\text{O}_{3-\delta}$ (LSCF) step between the current collector and the yttria-stabilized zirconia (YSZ) electrolyte is free from gold, proving successful patterning. The composition is dominated by Sr (peak at 2050 eV), while some La is found at 2800 eV, and no Co or Fe peaks are visible as shown in prior work on LSCF bulk samples [2].

As expected from previous studies, the YSZ spectrum does not show a distinct peak for Zr or Y, but only a step at approx. 2100 eV, indicating those elements are present one or two monolayers below the surface. The surface is likely terminated by inorganic contaminations (Na, Si, Ca) segregated from the bulk, not detected under the conditions used here, which would be consistent with studies on bulk YSZ [3]. In addition, a trace of La can be seen in the inset, indicating segregation from the LSCF step to the YSZ electrolyte. This may have occurred during the patterning or during electrochemical testing of the sample.

Reconstructed spectra from the different regions of interest, the gold current collector, the LSCF step and the YSZ electrolyte
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