MATERIALS

Characterisation of fuel cells and hydrogen storage materials and devices

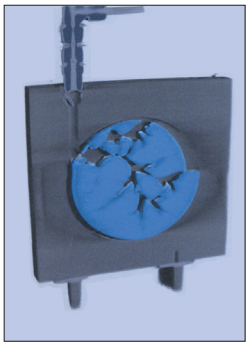
Neutron characterisation techniques can:

- Show **where H_2 is flowing** within a storage tank or a fuel cell.
- Show where and how **H_2 is fixed and released** by storage materials.
- Investigate **membrane** materials and **fuel cells** in operation.

Typical areas of study:

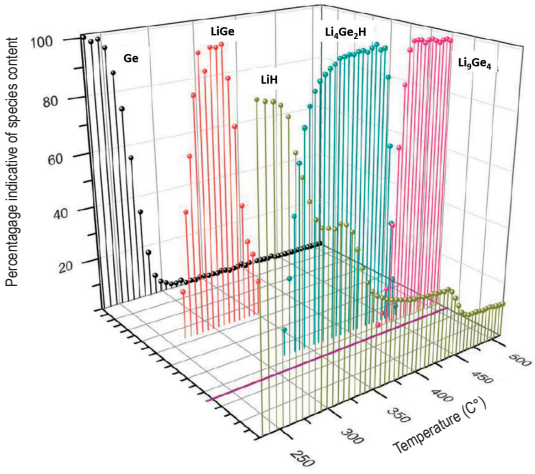
- H_2 storage materials: H_2 uptake and release under various operating conditions.
- H_2 storage devices: in operando H_2 imaging.
- Materials for fuel cell membranes.
- Fuel cells in operation: tracking water distribution within the cell at the μm level.

Examples



A neutron tomography image. It reveals the development of defects in a **light metal hydride storage material:** channels developing inside a hydrogen tank after two cycles of loading and unloading with hydrogen.

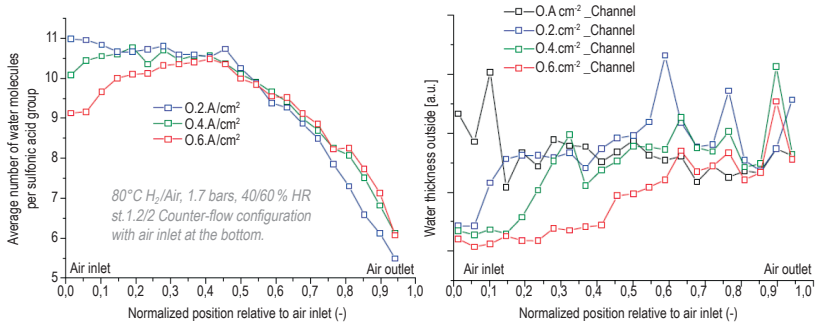
Dehydrogenation pathways in an **H_2 storage material**. Powder neutron diffraction experiments on a lithium-hydride/germanium composite (LiH/Ge) can reveals the species that form as the composite decomposes when slowly heated to 500°C.



A fuel cell membrane material.
Beside as an example: the refined crystal structure of bismuth niobium oxide obtained from neutron diffraction data.

- *Bismuth atoms*
- *Oxygen atoms*
- *Polyhedra-centred niobium atom*

Small-angle neutron scattering techniques make it possible to **measure the variation in water content** in both the vertical and horizontal planes throughout the **fuel cell** simultaneously. (*Left*) Water content in the menbrane and (*right*) water outside the membrane, along the flow field in the channel, for different current densities.



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HZB Helmholtz Zentrum Berlin

MLZ Heinz Maier-Leibnitz Zentrum

GEMS German Engineering Materials Science Centre Helmholtz-Zentrum Geesthacht

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