Tipsi Hybrid spectrometer at the planned European Spallation Neutron Source (**ESS**):

Probing different length scales simultaneously

N. ALIOUANE

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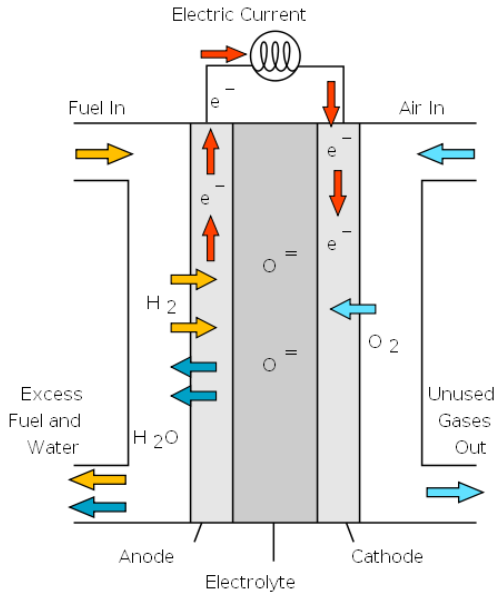
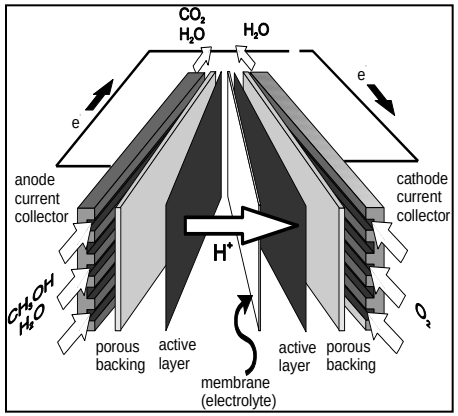
Motivations

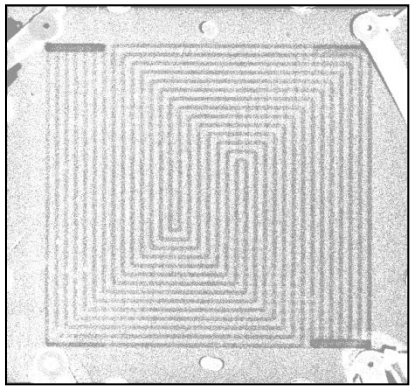
The performance of system/materials is the convolution/interplay between material lengths scales

Example: Solid oxid fuel cells (SOFC)

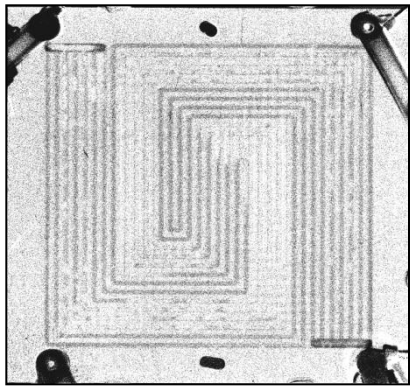




Neutron imaging



Completely fuel filled cell



During operation: CO_2 has removed the methanol in parts of the cell

A.Geiger, E. Lehmann, P. Vontobel, G.G.Scherer
General Energy Departement & NUMM, PSI

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Goal

- Materials ***in operandi*** and ***in situ*** at **multiple length scales with high time resolution**
- Access different length scales rather different experimental setups
- Simultaneous collecting:
  - neutron powder diffraction (NPD),
  - small angle neutron scattering (SANS)
  - neutron imaging (NI)

Technique	Powder Diffraction	Small Angle Scattering	Imaging
Length scale (approximate)	0.1-50	10-5000 nm	0.01-100 mm

Techniques and length scales and beam Characteristic

	Length scale (Å)	Techniques (TOF)	
Phase identification	0.5,50	Diffraction	R~1-4%, ϕ=thermal/cold, div~0.2^0
Local order/defects	1, 200	Diffraction (total scattering)	0.1<R<1%, ϕ~0.2-0.4Å
Meso/μ–structure	20-1000	SANS SeSANS	$\Delta Q/Q$~10%,div<<0.2, ϕ=cold (>6Å)
Internal strain	1- 50	High resolution Diffraction	R~0.3% div~0.2^0
Imaging	0.001-1mm	Tomography Imaging	R,ϕ,$\Delta\lambda$=Variable,
Texture	10-600	Azimuthal diffraction	R~0.3% ϕ=thermal, div~0.2^0

R=$\Delta Q/Q$, Q=$4\pi\sin\theta/\lambda$, ϕ=peak flux $\Delta\lambda$=band width div=beam divergence

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Conceptual designed