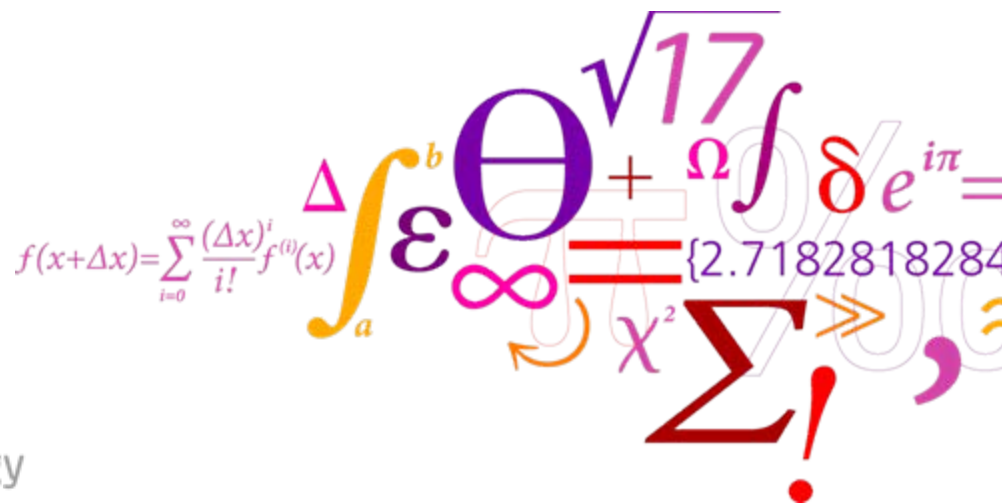


Risø competences in SOFC R&D ; Critical Issues for the Technology

Anke Hagen

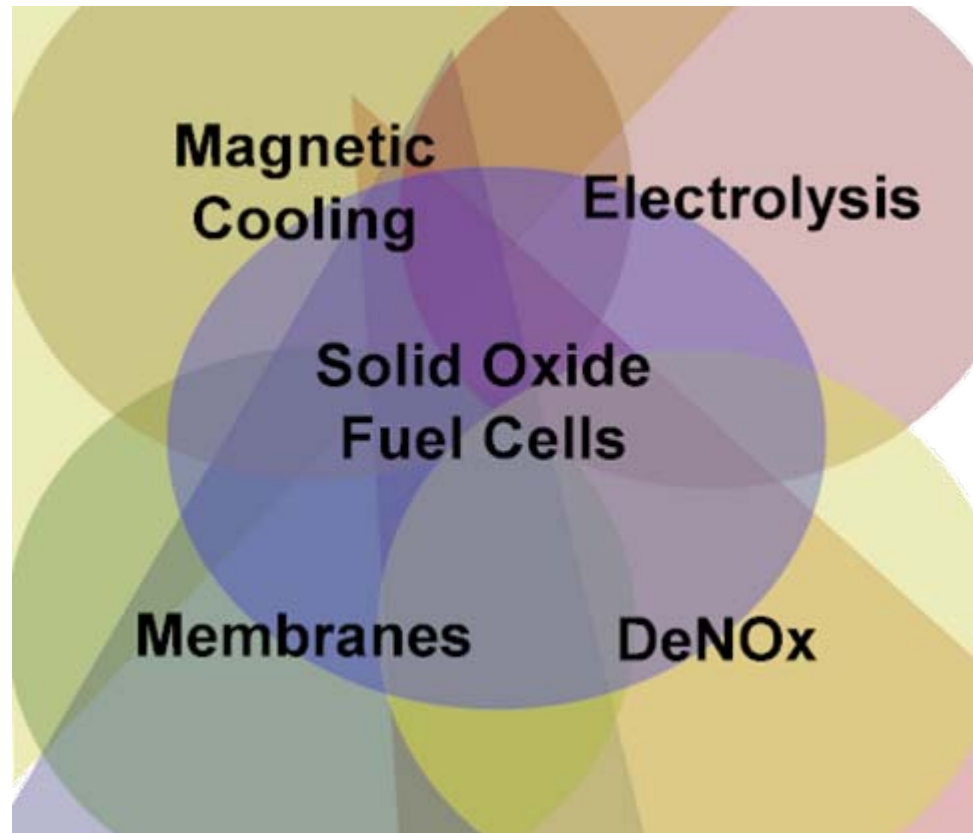
Head of Program

Fuel Cells and Solid State Chemistry Division

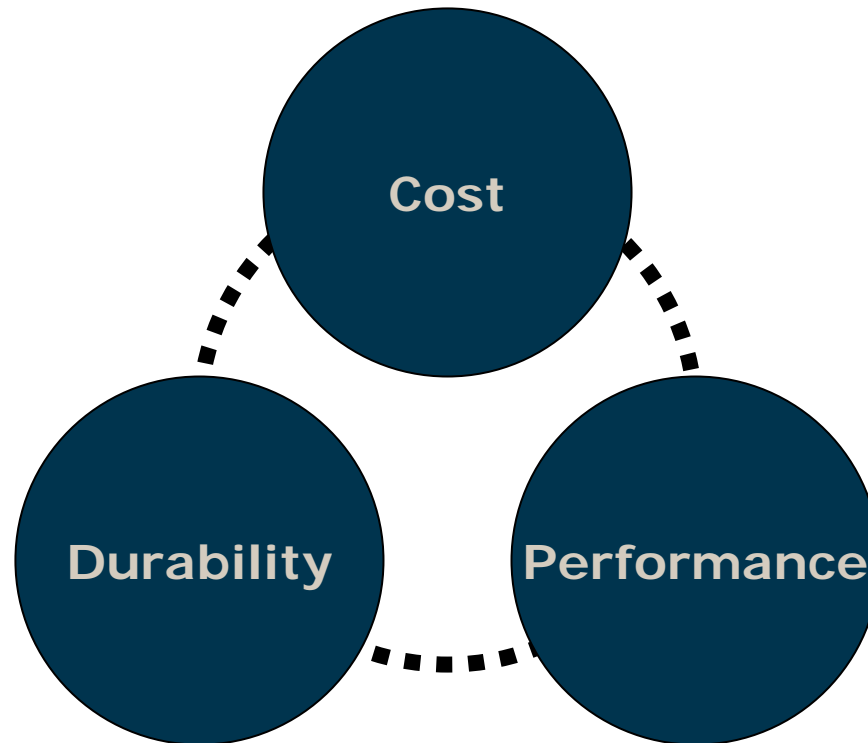


Fuel Cells and Solid State Chemistry Division

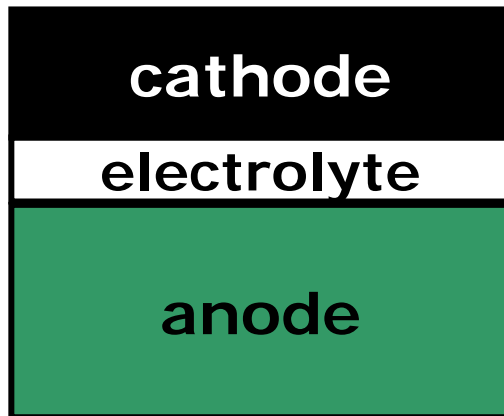
- Key competences: Advanced ceramic processing
Solid state chemistry
Solid state physics
- 120 employees
- Main activities:



SOFC Issues - General



SOFC Basic research



- Chemical composition (LSM, LSCF, LSC, ...)
- Micro structure (small particles, larger particles, ...)
- Barrier layers
- Conductivity (YSZ-SSZ)
- S-tolerance
- Coking tolerance
- Redox stability
- Coking and S-tolerance
- **Ni-anodes – Ceramic anodes**
- Metal support
- Ceramic support

Ceramic Processing

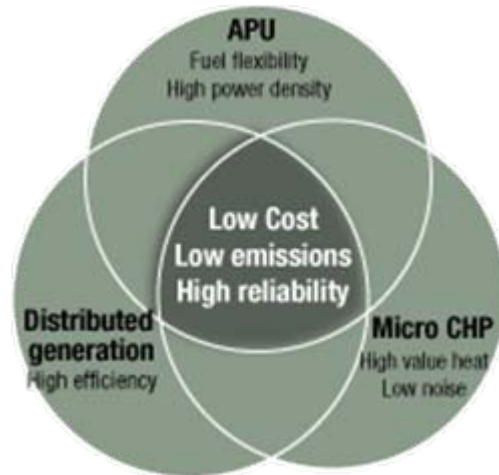
- Study of cost competitive deposition methods
- Processing of multilayer components that are stress-free
- Reproducibility of all processing steps

Stacking

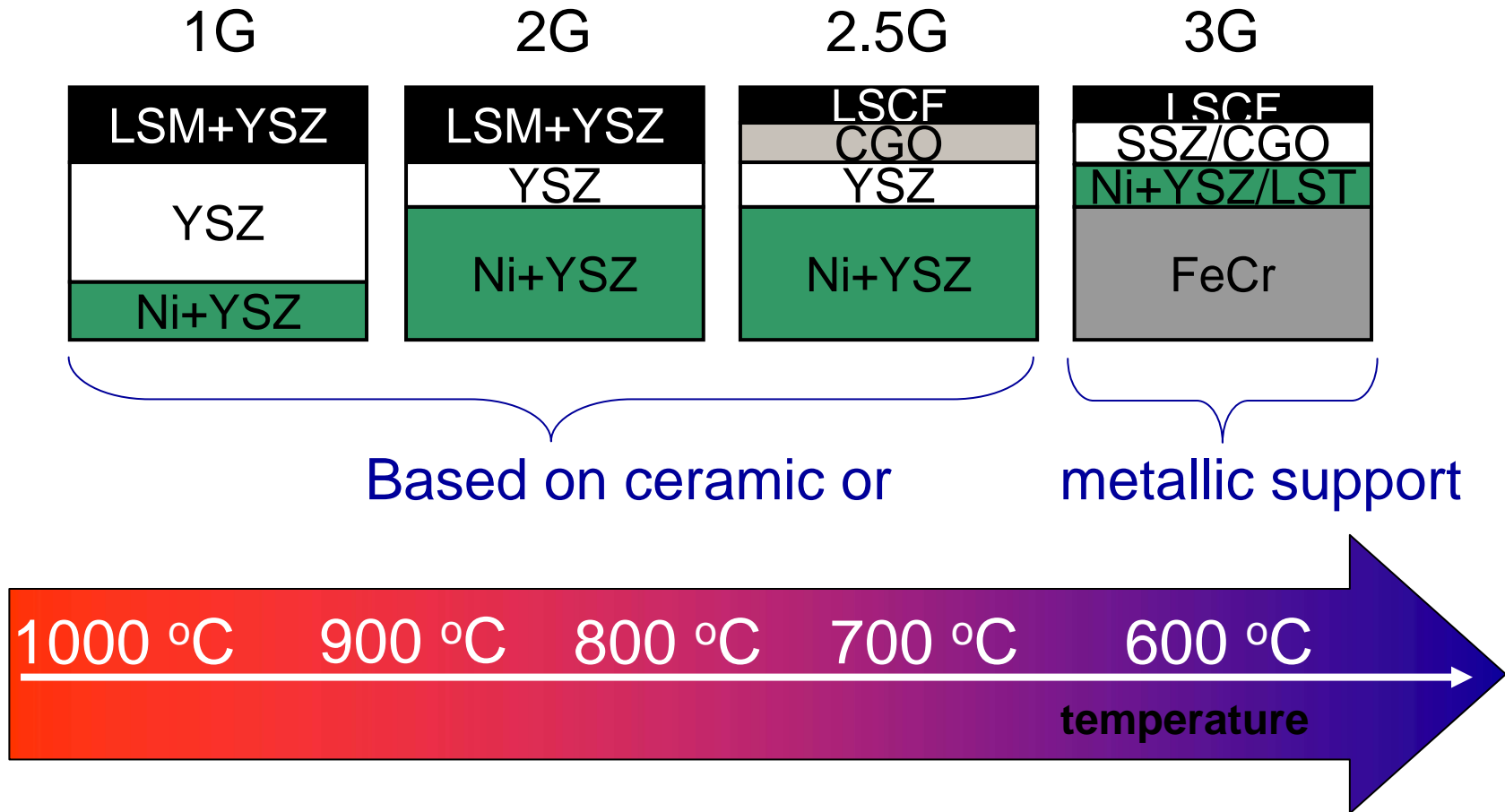
- Seals
- Interconnect materials
- Protective coatings / deposition methods

**Importance of issues
depends on
anticipated
application areas**

SOFCs for different market segments



SOFCs for different operating windows



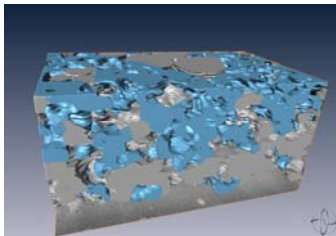
SOFC Basic research

Basic understanding as key for further improvements

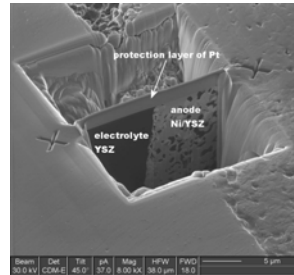
- Modelling (performance, thermodynamics, mechanical properties)
- Model systems – single cells – small stacks
- Detailed electrochemical characterization
- Advanced microscopy (FIB, TEM, SEM)
- Advanced characterization techniques (Controlled Atmosphere High Temperature Scanning Probe Microscope: CAHT-SPM)
- ...

Examples

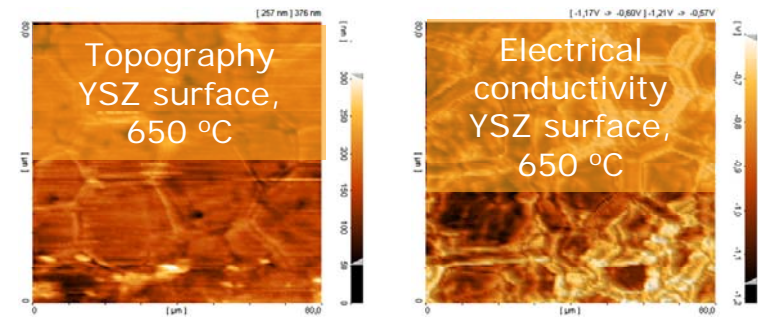
3D reconstruction



FIB, TEM, SEM

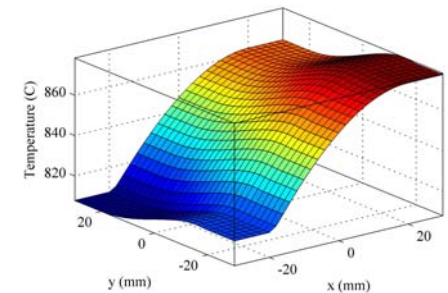


CAHT-SPM

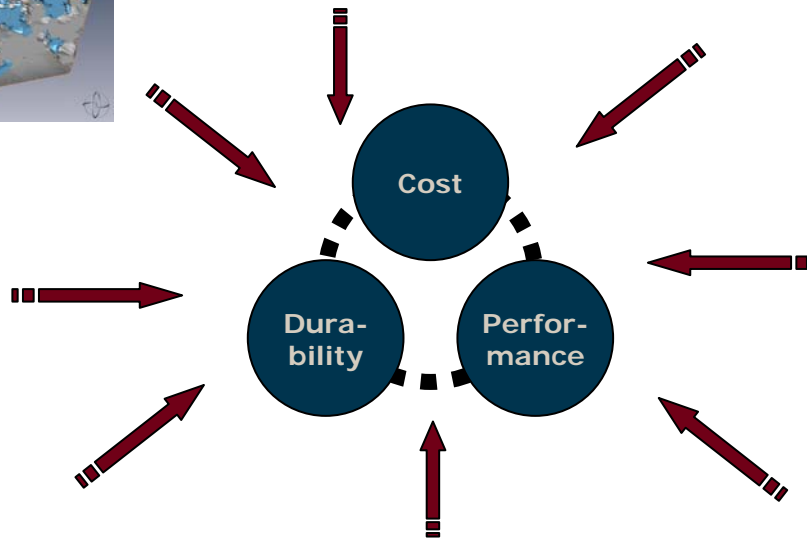
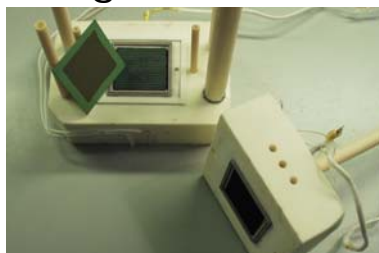


Cone shaped electrodes

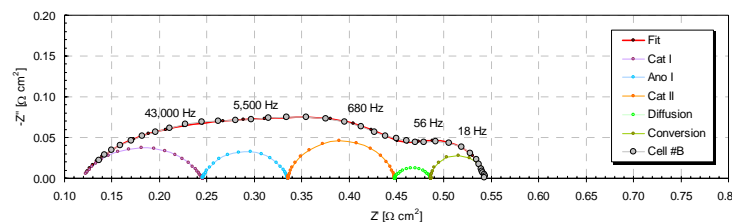
Simulated T-distribution



Single cell tests



Break down of losses in single cell



Thermodynamics of phase formations

