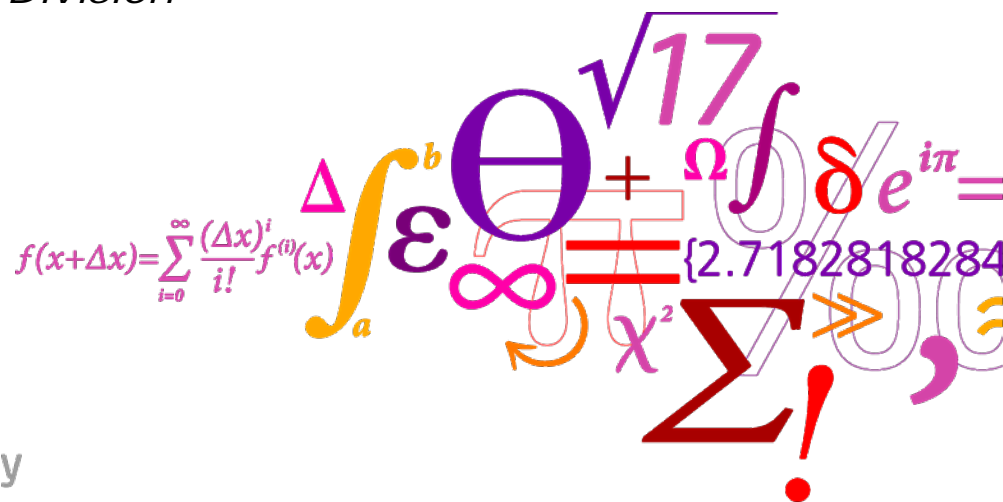


Welcome to Risø National Laboratory for Sustainable Energy – Risø DTU

Luise Theil Kuhn

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Head of the Program for Microstructures and Interfaces
Fuel Cells and Solid State Chemistry Division



Mission and Vision



● Mission

Risø DTU contributes to research, development and international exploitation of sustainable energy technologies and strengthens economic development in Denmark

● Vision

Risø DTU is one of Europe's leading research laboratories in sustainable energy and is a significant player in nuclear technologies. Risø creates pioneering research results and contributes actively to their exploitation, both in close dialogue with the wider society.



Bio Systems

- conducts research into technologies for converting biomass into bioenergy and biomaterials

- Power from wastewater and residual products: power generation by microbial fuel cells utilising wastewater and residual products from the pretreatment of straw!

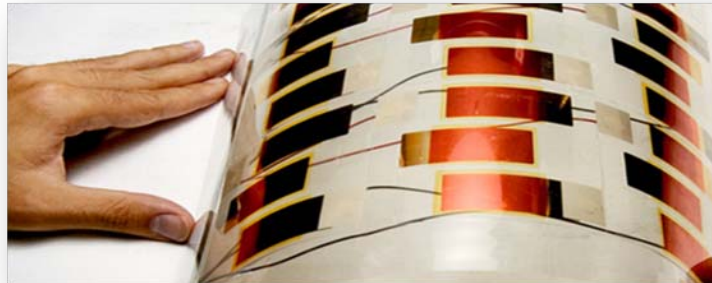


- Second generation biofuels
Biofuelled cars: a first step towards a transport sector with less CO₂ emissions than today.

Solar Energy

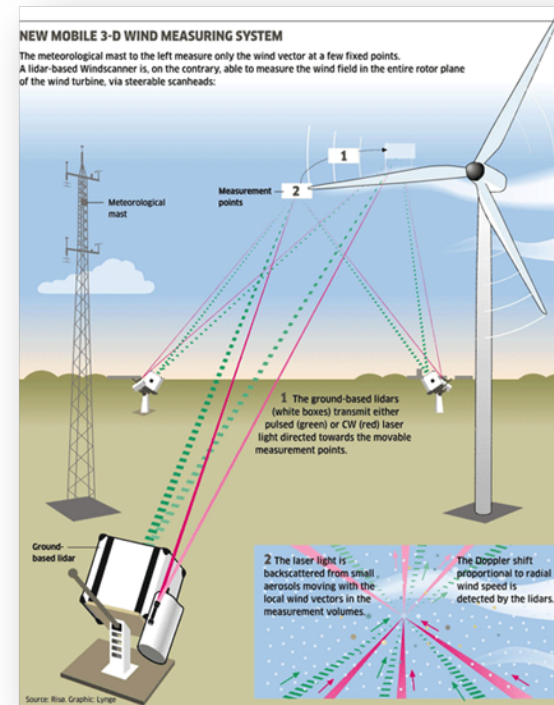
- conducts research on future generations of photovoltaic technologies and in particular polymer solar cells. In addition, we look into other means of utilizing sunlight; for instance to reduce carbon dioxide to synthetic fuels (solar fuels).

- A polymer solar cell lamp to provide reading light for school children in developing countries



Wind Energy

- conducts research in key areas such as meteorology, wind turbine technology, offshore wind, power system integration and materials. In addition we are involved in test and measurements, standards and certification as well as international projects.

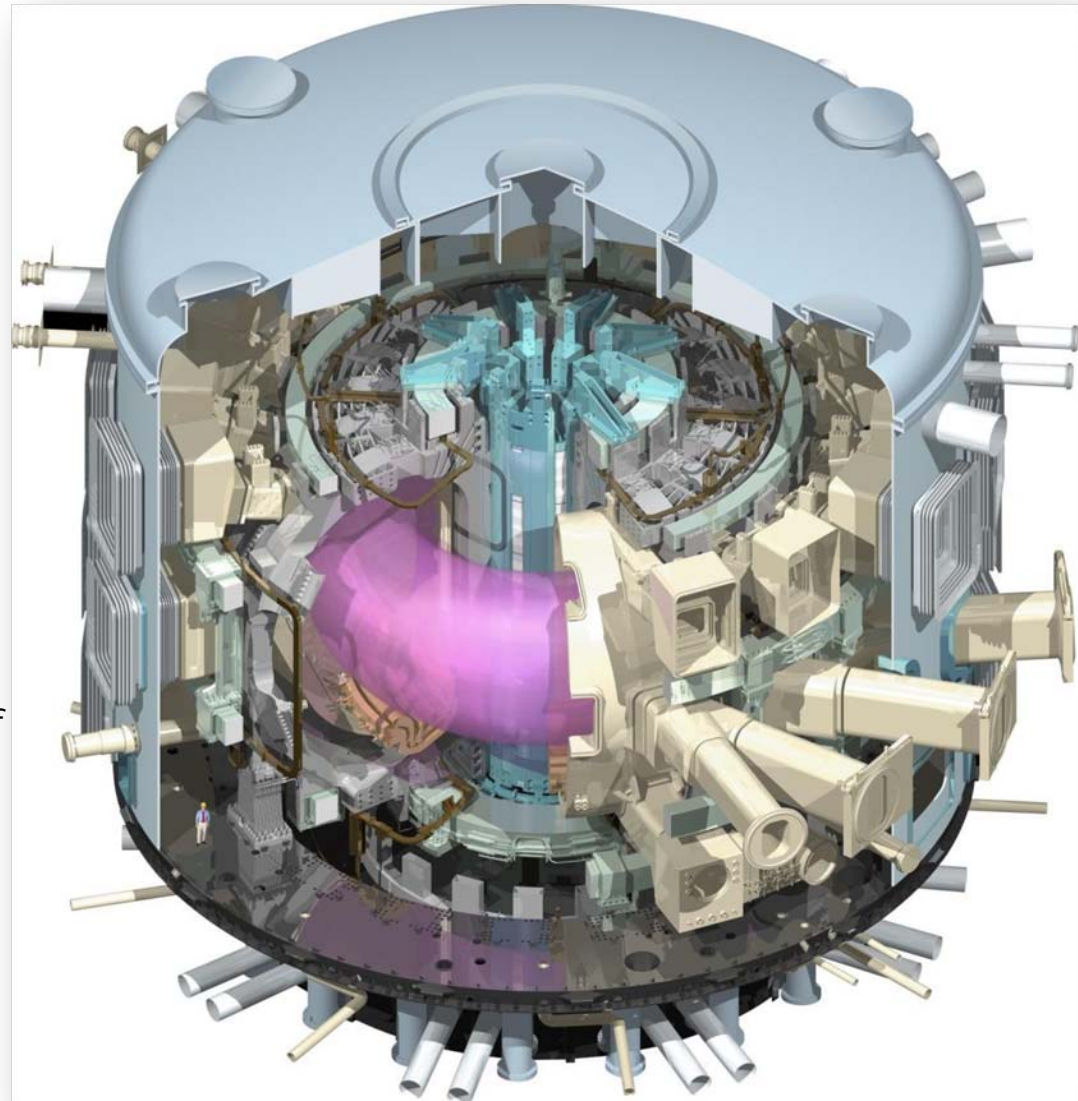


Fusion Energy

-conducts research in fusion, e.g. the European program, Euratom: JET (Joint European Torus) And the ITER project.

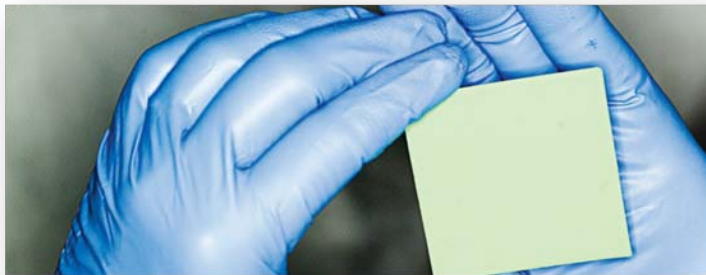
- ITER is a large-scale international scientific experiment
 - produce 500 MW energy from fusion from 50 MW of input power, the first of all fusion experiments to produce net energy.

A cutaway view of the future ITER Tokamak

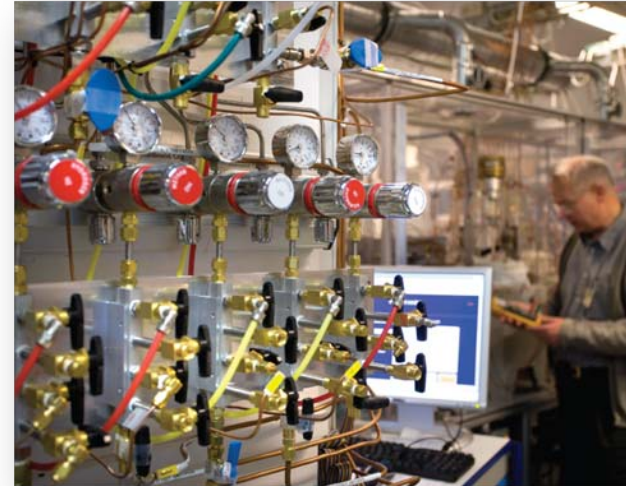


Fuel Cells and Solid State Chemistry

- conducts research in advanced functional materials for energy efficient technologies, for instance fuel/electrolysis cells, flue gas purification, membranes for gas separation and magnetic refrigeration.



■ We are supplying the basic knowledge for Denmark's production of solid oxide fuel cells and setting up a national test center for the technology.



Energy Systems

- conducts research in energy policies and energy systems with particular focus on environmental and climatic consequences.



- Global challenges:
 - strengthen the security of supply – also in the developing countries.
 - ensure reduced emissions of greenhouse gasses.
 - contribute to fighting poverty by delivering reliable and affordable energy.



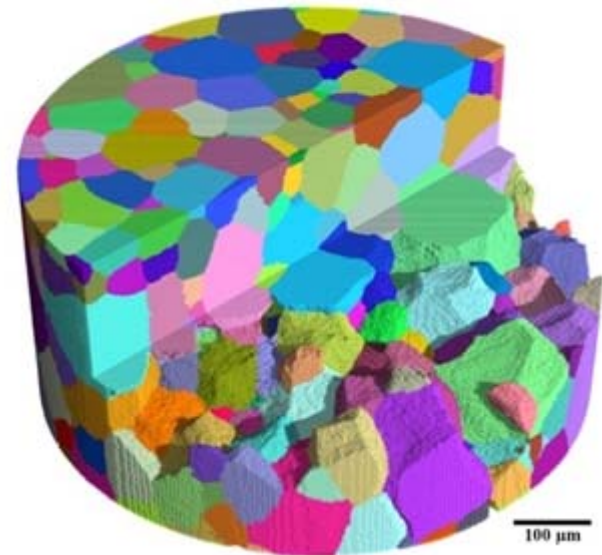
Materials Research

- conducts research in materials and materials technologies to find economically feasible and safe applications for advanced materials.



• Strong and flexible composite materials for wings for wind mills

• Modelling in 4D of the mechanical properties of metals and alloys



Radiation Research

- conducts research in radiation and radioactive isotopes in environmental samples and on the application of isotopes and nuclear technologies in medical sciences.



- Dating of sediments at Mars:
 - new insight into climate changes

- The Hevesy Laboratory produces isotopes and radioactive tracers for research and medical purposes and conducts research in the development of new radioactive pharmaceuticals



Business relations

The commercial activities consist of a wide range of innovation activities, cooperation with industries and products and services.

Through a specific innovation activity we systemize the transfer of our knowledge to concrete business ideas

- Cooperation contracts with companies
- Start-up companies
- Solutions to technological challenges in connection with creating new products
- Assignments for private companies and others on commercial conditions
- Sale of specific products, where Risø have a special expertise



Facts and Figures



🌿 People

639 full-time employees

~ 1/3 scientific staff

~ 1/3 technical and administrative staff

~ 100 Ph.D. students

~ 100 guest scientists, other students

🌿 Money

~ 620 Mill. DKK (€: 84 Mill., \$: 103 Mill.) per year

~ 1/2 external funding or industry



🌿 9 Research Divisions

Bio Systems

Intelligent Energy Systems

Systems analysis

Fuel Cells and Solid State Chemistry

Materials Research

Plasma Physics and Technology

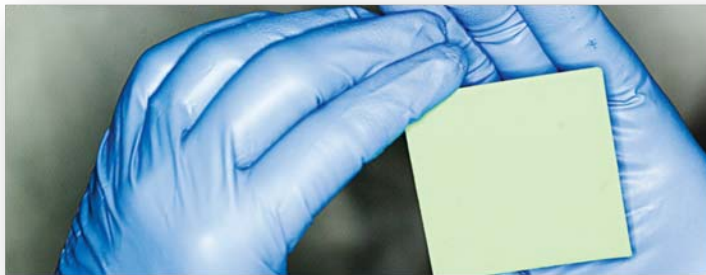
Radiation Research

Solar Energy

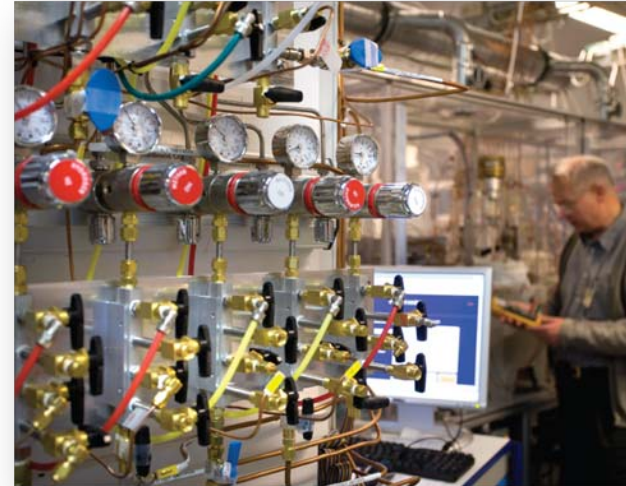
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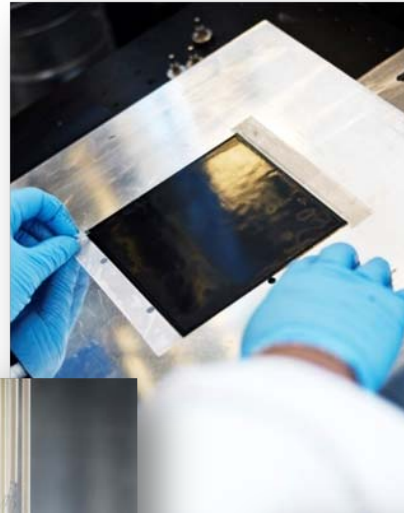


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Research and Competences

- Ceramic processes
- Materials development
- Characterization
- Advanced test
- Modelling



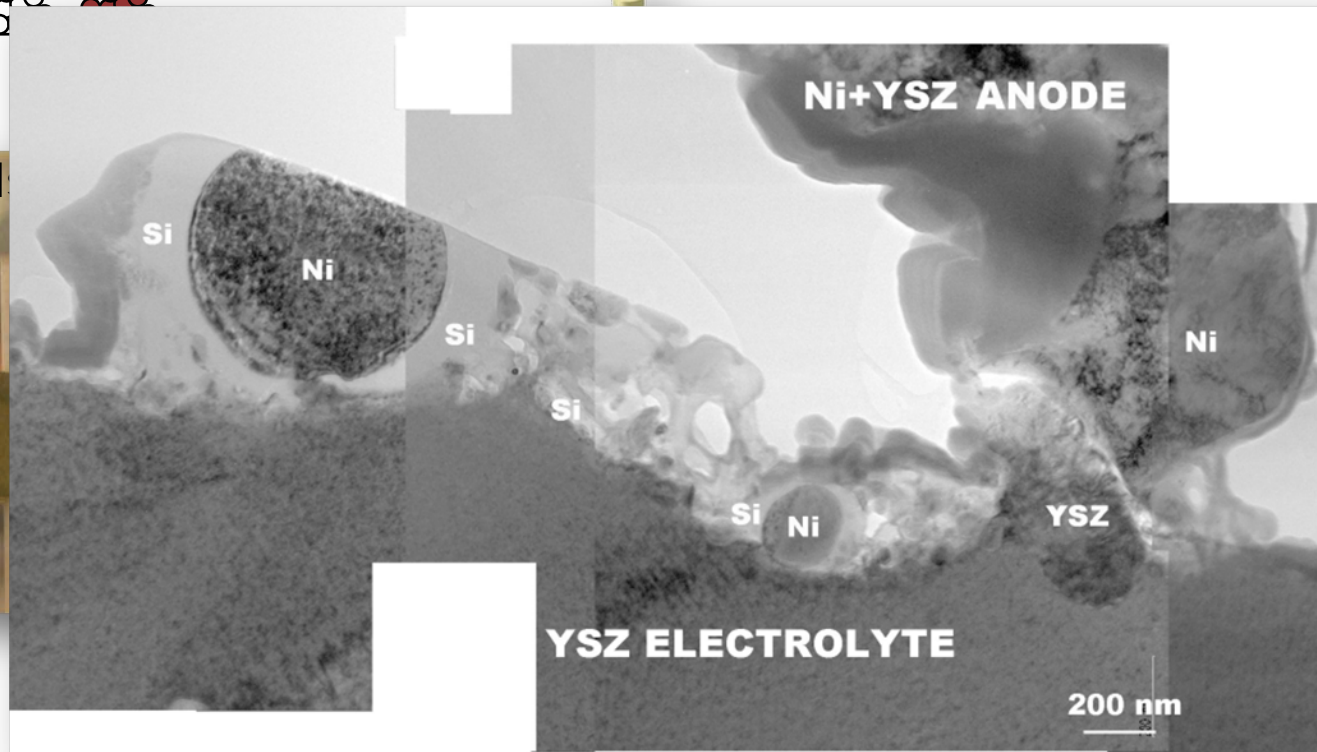
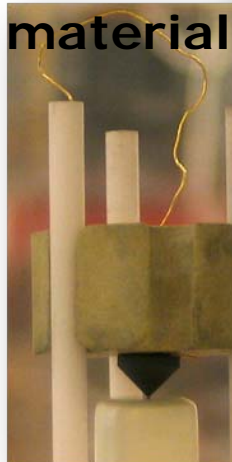
Technologies

- Fuel cells (SOFC)
- Electrolysis (SOEC and AEC)
- Magnetic refrigeration
- Membranes for oxygen or hydrogen separation
- Electrochemical flue gas purification
- Thermoelectrics
- Batteries
- Test and approval centre:
Fuel cells and hydrogen technologies



Microstructure analysis

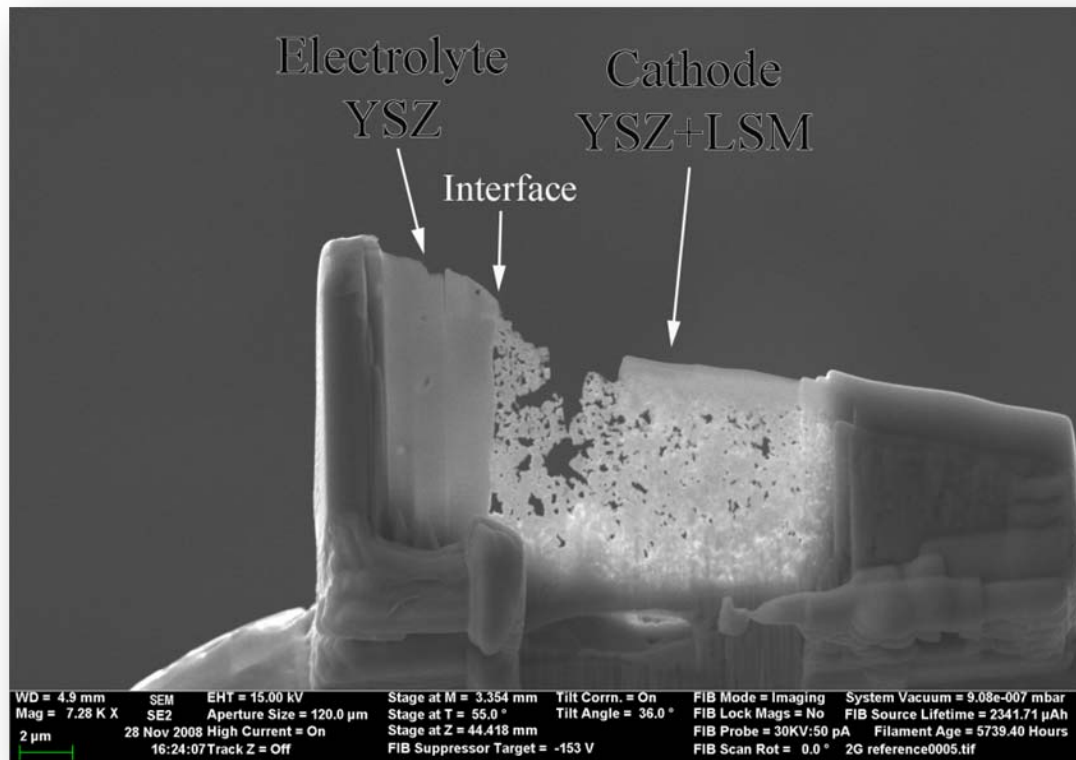
raw materials



microstructure

Analytical Electron Microscopy

TEM analysis for identifying what happens near the cathode/electrolyte interface and gaining more understanding concerning the causes of degradation in SOFCs tested under various conditions

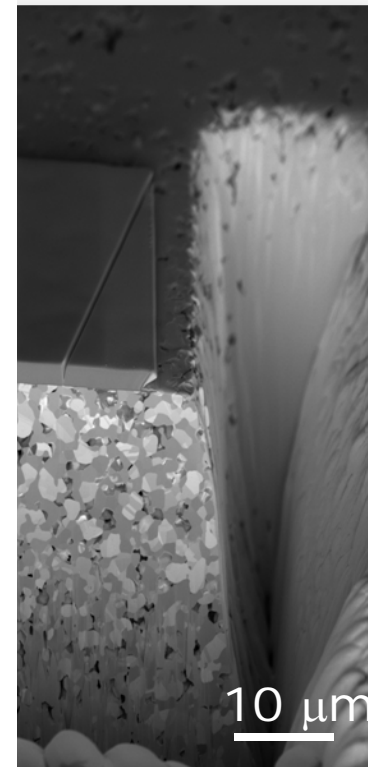
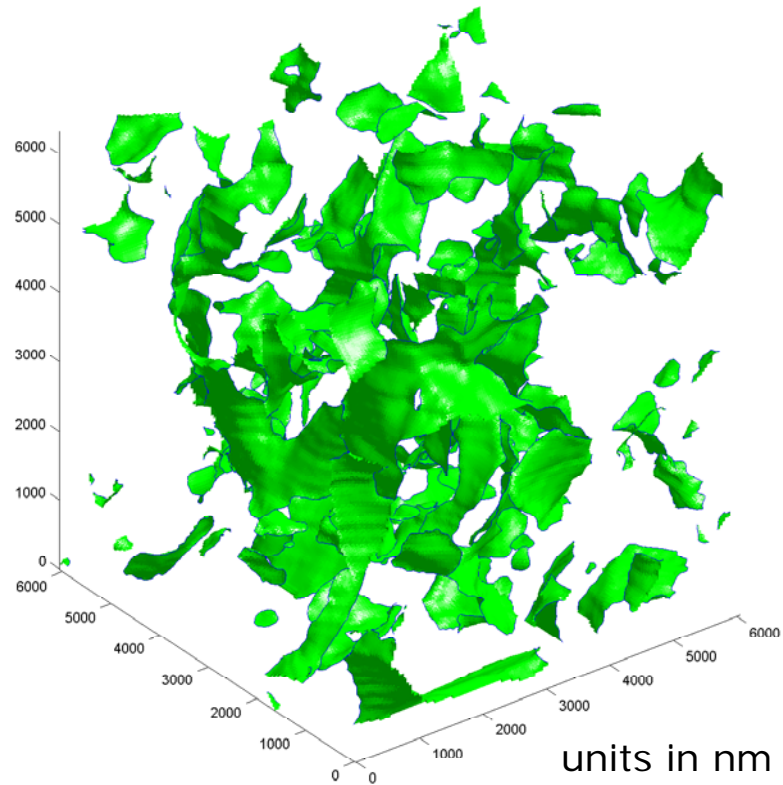


TEM sample prepared by FIB

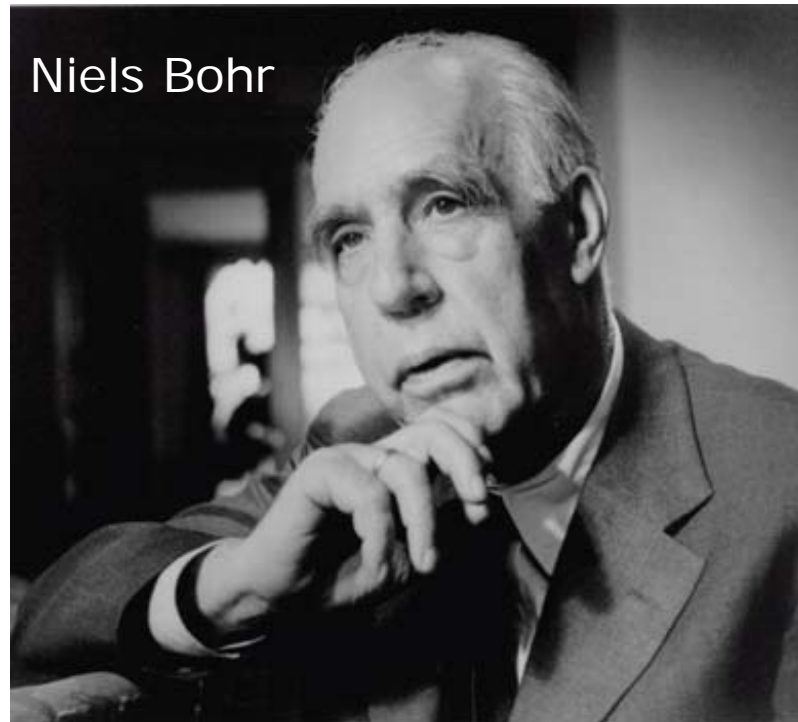
Analytical Electron Microscopy

Sample: Ni/YSZ anode

Ni – Pore interface



Risø's history



Niels Bohr

1953, The Atomic Energy Committee:
 Niels Bohr, Prof. Univ. Copenhagen
 J. C. Jacobsen, Prof. Univ. Copenhagen
 Torkild Bjerg, Prof. Techn. Univ. Denmark
 Haldor Topsøe, Industry



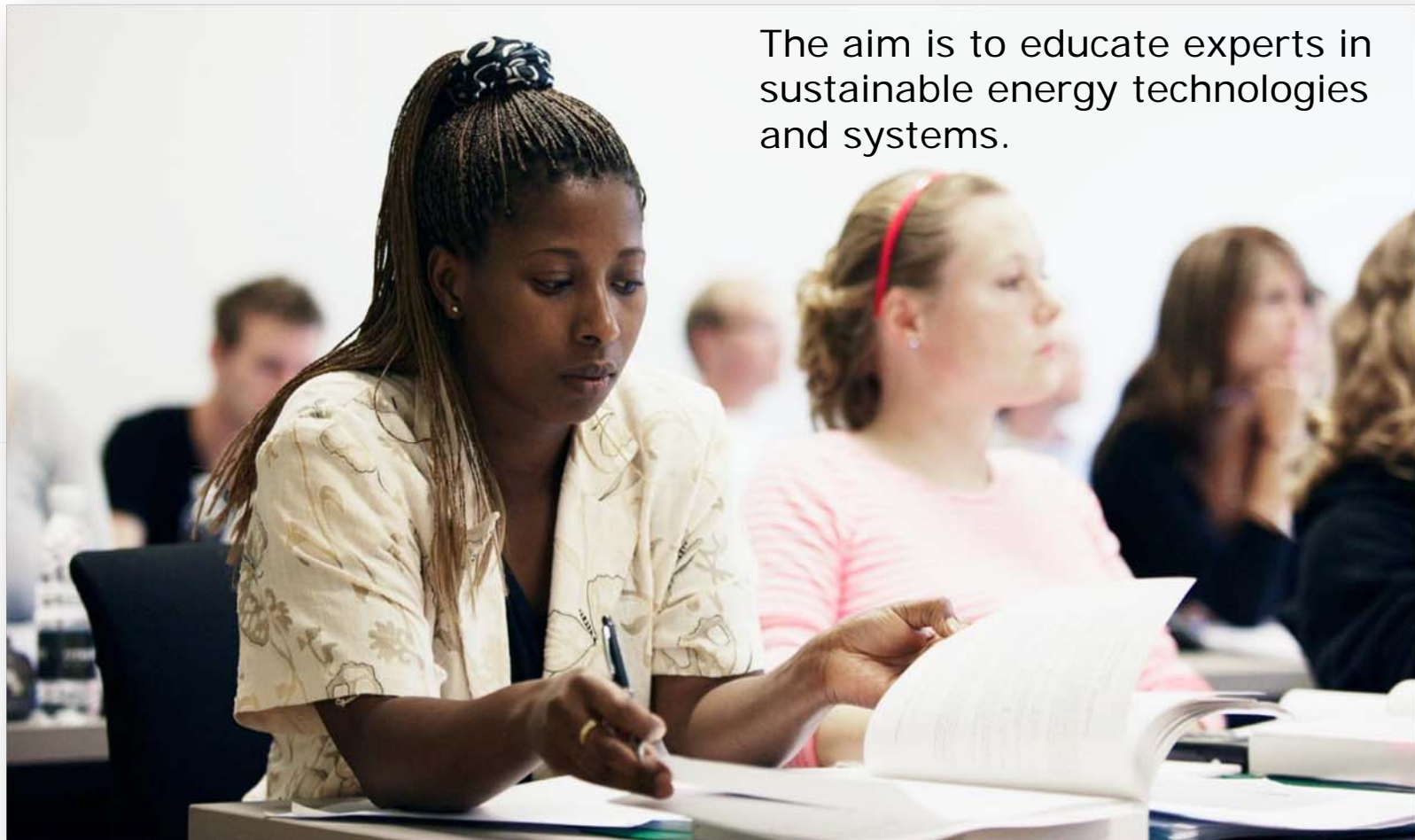
Haldor Topsøe

Strategic research

- Sustainable energy and nuclear technologies
- Problem-driven research
 - close dialogue with industry and politicians
- Impact on society within
 - sustainable energy supply
 - climate change mitigation
 - nuclear technologies for the diagnosis and treatment of diseases
 - higher quality of life
 - new job opportunities



Master of Science in Sustainable Energy



The aim is to educate experts in sustainable energy technologies and systems.