ABOUT THE DEPARTMENT

The Department of Energy Conversion and Storage focuses on education, research, and development within functional materials and their application in sustainable energy technologies. The Department has 230 employees.

ABOUT DTU

The Technical University of Denmark (DTU) is one of Europe's leading technical universities. DTU develops and creates value using the natural sciences and the technical sciences to benefit society. The university has 5800 employees, including 1200 PhD students, and more than 10,000 BEng, BSc and MSc students.

FURTHER INFORMATION

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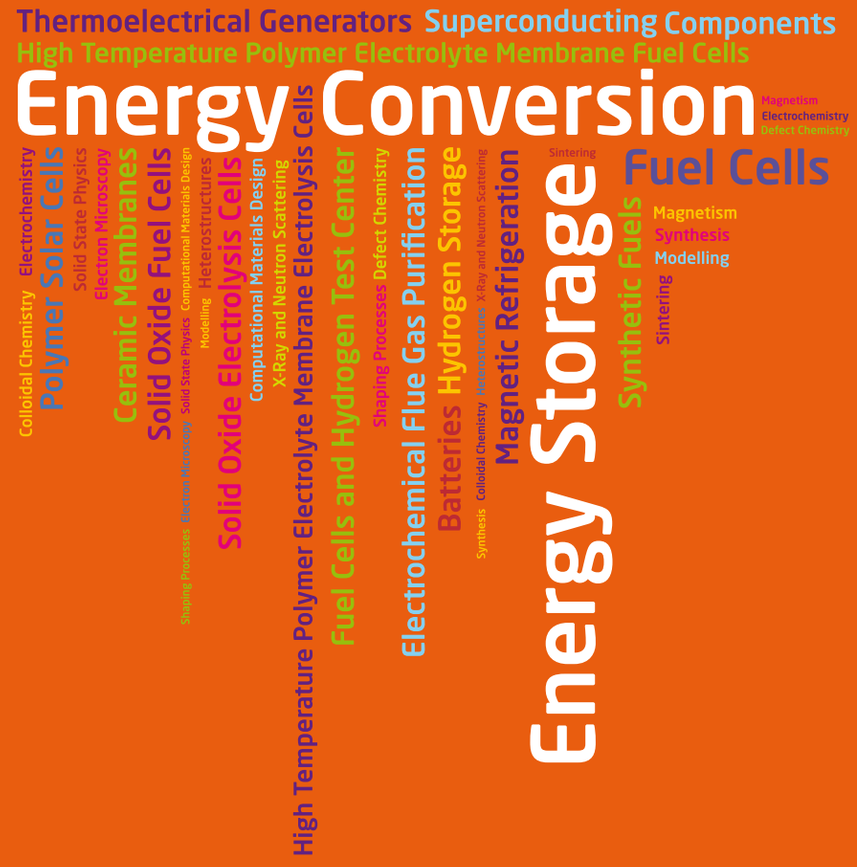
DEPARTMENT OF ENERGY CONVERSION AND STORAGE



DTU Energy
Department of Energy Conversion and Storage

ENERGY CONVERSION AND STORAGE

In a sustainable energy system, a large part of the energy will be supplied by fluctuating sources such as solar and wind power. This makes it critically important to be able to convert and store the energy as needed.
The researchers in the Department of Energy Conversion and Storage are working on technologies and materials for the direct conversion and subsequent storage of various forms of energy. For example, wind power can be stored by converting electricity into hydrogen, which can then be stored in solid state. The key technology areas of the Department include fuel cells, electrolysis, batteries and solar cells. Such technologies will play an important role in any future energy system based on sustainable energy sources.

FUNCTIONAL MATERIALS

It is common to all our technologies that they depend for their operation on functional materials – materials with specific electrical, magnetic, thermal, chemical or electrochemical properties. Electron- or ion-conducting ceramics have applications for fuel cells (solid oxide fuel cells, SOFC) and electrolysis cells, photovoltaic polymers can be used for polymer solar cells, and some magnetic materials have applications as active components for efficient refrigeration devices. Research at the Department includes many different aspects of functional materials and their applications in energy technologies.

FUNDAMENTAL INVESTIGATIONS

Our research and development span all the way from fundamental studies of nano-scale processes, e.g., in electrodes to the demonstration of a new technology. One important task is to understand the correlation between the microstructure and the performance of a component, and to implement this understanding in predictive models which can guide the development. We test devices, such as fuel cells or solar cells, extensively with regard to performance and stability, and under various operation conditions. They are also characterized in great detail using methods such as scanning and transmission electron microscopy and X-ray scattering.

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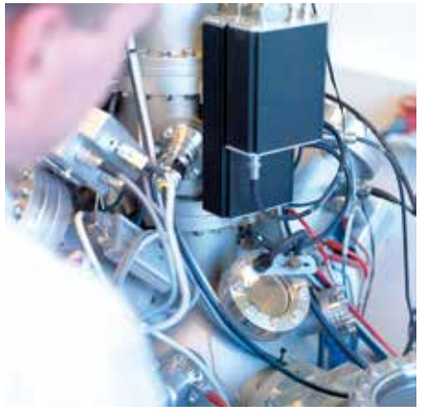
PROCESS DEVELOPMENT

One critical challenge in the development of components with high performance and durability is to bridge the gap between a promising lab result and mass production using cheap and reproducible processes. To meet this challenge, a large part of our development takes place using scalable industrial forming methods: The active layers in our solar cells are deposited using roll-to-roll techniques known from the printing industry, and the development of ceramic components takes place in a process lab facility with an annual capacity of tens of thousands of fuel cells. Among the methods used are tape-casting, screen printing, spraying and extrusion.

To be able to manufacture components of a desired geometry and microstructure, it is necessary to have a deep understanding of the many parameters controlling the forming processes. Consequently, the Department's research includes fundamental aspects of topics such as powder preparation, colloidal chemistry, shaping techniques, drying, and sintering.



TECHNOLOGY FOCUS

It is our strong belief that the best results are obtained by having technological development take place in close interaction with fundamental research. Our research is organized into a number of technology tracks: Fuel cells, electrolysis, solar cells, batteries, gas separation membranes, magnetic refrigeration, thermoelectric components, flue gas purification, and superconducting components. In addition, the Department operates a test centre for fuel cells and hydrogen technologies where industry can get components tested.

An important way to ensure the relevance of our research is by having close collaboration with Danish and international industry partners. With regard to fuel cells, we have a successful collaboration with the company Danish Power Systems A/S, and within solid oxide electrolysis we collaborate with Haldor Topsøe A/S. We also work together with industry in several of our other focus areas, including solar cells and magnetic refrigeration.

A MULTIDISCIPLINARY APPROACH

One of the characteristics of research within energy conversion and storage is the need for many different competences from traditionally separate fields of science. Our researchers include experts in electrochemistry, synthesis, solid state physics, electron microscopy, catalysis, process technology, rheology, modelling, and many other fields.

EDUCATION

The department offers courses at DTU within the MSc program "Sustainable Energy" and is responsible for the study line "Fuel Cells and Hydrogen" – an industrially oriented program focusing on efficient energy technologies based on fuel cells and hydrogen technologies. We have a strong commitment to researcher education with more than 60 PhD students taking part in the Department's dynamic, international research environment. Every year, the Department offers summer projects which give students the opportunity to work in a research laboratory.

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www.energy.dtu.dk