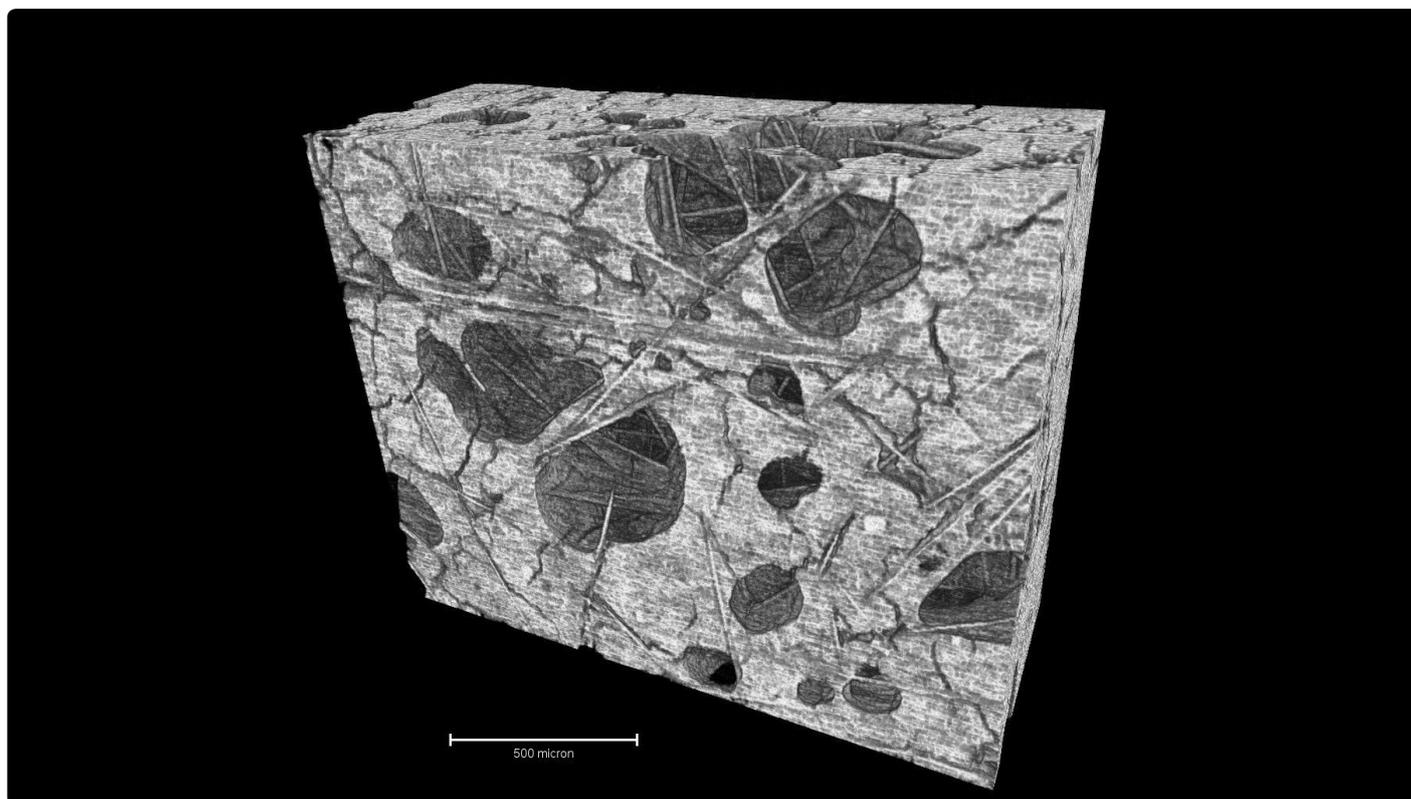


CT Scans to the Aid of Catalysis

Haldor Topsøe A/S

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CATALYZING YOUR BUSINESS



As much as 60 % of all industrial products are made using catalysts. Catalysts enable processes to be carried out under industrially feasible conditions of pressure and temperature. Catalysts based on supported porous materials can suffer from intra-porous diffusional resistances which dramatically lower catalyst efficiency. The diffusion rate of reactants and products is diminished inside the pores and the molecules entering the smallest pores diffuse slower, since they hit and bounce the walls of the pores.

A good knowledge of the pore size, shape and connectivity is needed to optimize catalyst performance. Therefore at Haldor Topsøe A/S, a world-leading supplier of catalysts, the catalyst pore system is studied thoroughly using several in-house techniques on a routine base.

Haldor Topsøe A/S has had activities in the field of X-ray tomography for the last eight years both in synchrotrons and laboratory facilities. X-ray tomography can provide both a 3D visualization of the pore system and a quantification of the pore volume.

CT scans were performed under in-situ conditions

By image analysis it is possible to determine parameters like pore connectivity (tortuosity), pore size and pore shape for catalysts. However, the reachable pore scale depends on the instrument used and the sample size. Furthermore, few techniques provide informa-

tion on the biggest pores (macro-pores), making X ray tomography an extremely interesting technique. Aspects related to the catalysts solid part like density distribution can also be studied by X-ray tomography. Especially when taking advantage of the added third dimension (3D) to the traditionally 2D imaging of surfaces, e.g. by scanning electron microscopy.

Haldor Topsøe A/S has been seeking a strong partner to exploit the capabilities of the X-ray tomography technique including both data acquisition and data analysis. The collaboration established in 2014 with the DTU Imaging Industry Portal is extremely fruitful and fulfils all expectations. A range of catalysts from Haldor Topsøe A/S were scanned with X-ray CT (Computed Tomography) at the DTU facility in 2014.

Further, a collaborative project devoted to studying fundamental aspects of catalyst preparation by CT scanning under in situ conditions was started and is running efficiently and smoothly. Fast access to the CT instrument makes it possible to keep a high tempo.

Further detailing soon possible

The X-ray tomography technique could be taken to even higher levels in the future, explains Postdoc Søren Bredmose Simonsen of DTU Imaging Industry Portal and DTU Energy Conversion:



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“At the ESS and MAX-IV facilities soon to open in Lund, it will be possible to study larger samples or to see the pores in even greater resolution. Here at DTU we are able to see the sizes and shapes at micron level, which is fine for this particular project, but at MAX-IV in Lund you may take things further to the nano scale.”

The two facilities in Lund are scheduled to open in 2019 (ESS) and 2016 (MAX-IV). However, the DTU Imaging Industry Portal is able to assist companies already today with experiments at international large-scale facilities elsewhere.

New Horizons Are Opening to the Energy Sector

World leading facilities within neutron and X-ray scattering, the ESS and MAX IV, will open in the Oresund region over the next few years. However, there is no need to wait for these facilities to open. Scientists at Technical University of Denmark and University of Copenhagen are already in gear for X-ray and neutron scattering projects. These could either be full research projects in their own right or preliminary projects leading up to projects at existing or the coming large scale facilities. Contact the universities to learn more about what they can offer you.

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