

## PARTNER PROFILE

### NTNU - Norway

The Norwegian University of Science and Technology (NTNU) is Norway's primary institution for educating engineers and scientists. The university also has strong programmes in the social sciences, teacher education, the arts and humanities, medicine, architecture and fine art.

#### Profile of the catalysis group

KinCat, the catalysis group at the Chemical Engineering Department at NTNU (in collaboration with SINTEF Materials and Chemistry) has catalytic conversion processes as the main focus area. The laboratories and equipment include a large number of micro-reactors for catalyst studies, several small pilot plants, key techniques for catalyst and material characterization (chemisorption, physical adsorption, Temperature Programmed techniques (Temperature Programmed Reduction (TPR), Temperature Programmed Desorption (TPD), thermal analysis), IR/Raman spectroscopy, TEOM (Tapered Element Oscillating Microbalance for adsorption and coking studies).

Other key surface science techniques include X-ray Photoelectron Spectroscopy (XPS), Auger and Scanning Tunnelling Microscope (STM), as well as electron microscopy in collaboration with other departments. Material characterization using high energy X-rays is particularly useful, and the group has established a permanent set-up for *in situ* X-ray absorption and diffraction studies at the Swiss-Norwegian beam-line at the European Synchrotron Radiation Facility (ESRF) Grenoble, France.

NTNU carries out projects in a range of subjects:

- Biofuels (thermal and catalytic routes);
- Natural gas conversion (focusing on syngas chemistry, C2-C4 hydrocarbon upgrading);
- Hydrogen technology;
- Oil refining;
- Fundamental catalyst studies (including theory, microkinetic modelling, DFT-calculations);
- Carbon nanofibres (preparation using chemical vapour deposition as well as applications in energy related processes such as catalyst support for electrochemical and other catalysts, batteries and supercapacitors);

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Figure 1: The "Gløshaugen" campus of NTNU for Engineering and Science is close to Trondheim city centre.



Figure 2: The Fischer-Tropsch synthesis setup for catalyst testing.

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- New reactor concepts and structured supports (process intensification);
- Photocatalysis (for chemical energy conversion based on solar energy);
- Design and preparation of new catalysts and supports (especially size and shape-control of metal nanoparticles and inorganic supports).

#### Infrastructure available in BRISK

In BRISK, catalyst laboratories for syngas conversion are offered for Transnational Access. At NTNU, catalysts for fuel synthesis (Fischer-Tropsch, methanol and DME) can be tested for activity, selectivity and lifetime (deactivation) at conditions close to relevant industrial operation in terms of pressure, temperature and space time. If desired, the laboratory work can include performing basic characterization of the materials (surface area, TPR and chemisorption). The catalyst studies can be performed in conventional fixed bed reactors, or structured or micro-channel reactors can be applied. The units are equipped with on-line analysis of products using gas-chromatography.



Figure 3: Close-up of a micro-structured reactor used for fuel synthesis (see, for example, R. Myrstad et al., Catal. Today 147S (2009) S301–S304).



Figure 4: PhD student Henrik Romar (left) from Chydenius University Kokkola, Finland visited NTNU in 2012 with support from BRISK. He is pictured here together with local PhD student Andreas H. Lillebø (bottom right), working on the Fischer-Tropsch rig.

**KinCat**   
Catalysis Group – SINTEF – NTNU

 **NTNU**

#### Contact

For further details about how to apply to utilise NTNU's facilities as part of the BRISK initiative contact:

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