



# *Using neutron and synchrotron sources in industrial catalysis*

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***Catalyzing your business***

RESEARCH | TECHNOLOGY | CATALYSTS

**HALDOR TOPSØE** 

# Topsøe Group's headquarters in Lyngby, Denmark

- Group management
- Business units:
  - Chemical
  - Environmental
  - Refinery
  - New Business
- Engineering Production
- Catalyst Production
- R&D

- Established 1940
- Ownership: Haldor Topsøe Holding A/S (100%)
- Annual turnover (2012): ~700 MM EUR (> 5200 MDKK)
- Number of employees: ~2500



# Our business areas ... founded in heterogeneous catalysis

- Fertiliser industry (ammonia, ...)
- Heavy chemical and petrochemical industries (synthesis gas, methanol, hydrogen, ...)
- Refining industry (hydrotreating, hydrocracking)
- Environmental and power sector (DeNO<sub>x</sub>, WSA, SNOX)
- Renewables (e.g. biofuels, biochemicals)



# Key challenges for industrial use of RI's - 1

- Large expenses/benefit ratio and large distance to RI
  - travel, hotel, beam time/instrument time, equipment
- Many experienced researchers needed for one experiment
  - Complex experiments, unique results?, complex data analysis
- Peer review system for beamtime applications:
  - Judged on scientific quality,  
not on technological quality or industrial relevance
- Confidentiality, IPR, secrecy agreements, bureaucracy
- Beamline/experimental staff:
  - Lack of staff: experiments run 24 hours/day, but staff not always available
  - Lack of experienced staff (short-term contracts)
- Full remote control of experiments is hardly possible
- Extra facilities, e.g. preparation labs not always available

# Key challenges for industrial use of RI's - 2

- Differences with academic use of large-scale facilities:
  - Industry: larger amount of samples; model vs. real catalysts
  - Industry: faster results are demanded:  
robust methods + on-line analysis + fast access to facilities
  - Trend: reduced time from R&D to market
- Industry: product and process oriented  
RIs: method, instrument/beamline, fundamental understanding oriented
- Lack of quality control of beamlines/instruments:
  - no standard protocols
- Lack of automated on-line data analysis and reduction software
- Lack of standardization:
  - Interfaces between beamline and sample environment
  - Data formats
- Limited interest in industrial use by many RI's

# Increase of industrial use of SR

- Short access time to beamlines (2-4 weeks), preferably at short distance from home laboratories
- Professional and reliable operation of beamlines and synchrotron
- State-of-the-art beamline equipment, laboratories (also for sample preparation) and data analysis
- Building and operation of beamlines is responsibility of SR sources – industry is willing to pay for beamtime
- Beamline staff on long term contracts to improve competent service; basic understanding of catalytical processes performed present at beamline
- Coordination of industrial beamtime applications by an "industrial user office" to ensure use of the proper beamlines + scientific support

Partly from:

**Final declaration at "Industrieforum In Situ Charakterisierung Katalytischer Prozesse", Nov. 2003, Hasylab (Bessy, Anka)**