

TOP **NANO**

New Nordic research using nanotechnology to avoid problems with ice



Winterwind 2012, 7-8 February, Skellefteå

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YKI, Institute for Surface Chemistry



YKI, Institute for Surface Chemistry



Your Research and Innovation Partner
in Applied Surface Chemistry





YKI Mission

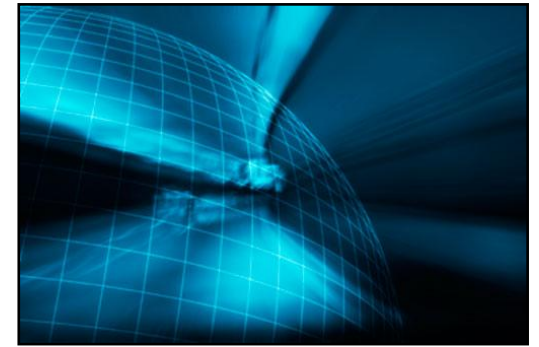
To develop and transfer competence, solutions and new technologies to industrial sectors where surface chemistry is of importance.

Services of YKI

- **Research projects**
 - Bilateral contracts
 - Industry and government funded consortium projects
- **Consultancy service**
 - Surface chemistry expertise
 - Analytical service
 - Feed back on new product and application ideas

YKI in brief

- Owner: SP Technical Research Institute of Sweden
- Employees: 65 persons
- Located at KTH (Royal Institute of Technology) campus, Stockholm Sweden
- Turnover (2010): SEK 68 Million (SP Group 1000)
- High level instrument park (reinvestment 6-12% annually)
- Extensive collaboration with universities and industrial institutes both in Sweden and internationally
- 35 member companies, of which 50% have their headquarters outside Sweden



Sectors where YKI work on applied surface chemistry



Biotech/Medtech



Cleantech



Polymers



Materials



Chemicals



Coatings



Foods



Printing



Cleaning



Pharmaceuticals



Personal and Beauty Care



Paper and Packaging



Instruments

YKI has a unique combination of instruments in the area of surface and colloid science.

The instruments are divided into following categories:

Liquid Surfaces

- Surface Tension
- Foams and Thin Films
- Adsorption at the Liquid Surface

Solid Surfaces

- Surface Modification
- Surface Analysis
- Adsorbed Layers
- Interaction Between Surfaces

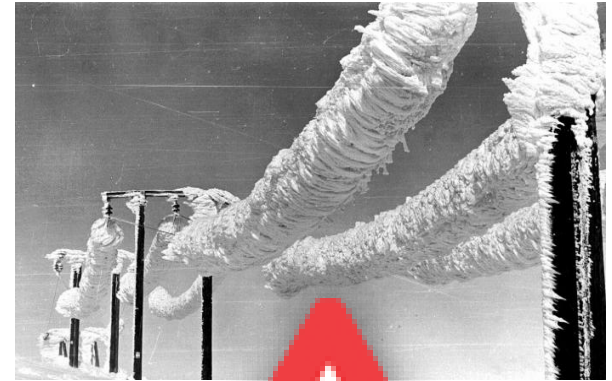
Particles and Dispersions

- Preparation
- Size and Distribution
- Physical Properties of Dispersions

Surfactant and/or Polymers in Solution

- Phase Behavior

Can nanotechnology solve ice and frost problems?



TIME	DESTINATION	GATE#	STATUS
12:00	COPENHAGEN	---	CANCELLED
12:15	PARIS	---	CANCELLED
12:25	LONDON	---	CANCELLED
13:20	FRANKFURT	---	CANCELLED
13:45	ZURICH	---	CANCELLED
14:35	BRUSSELS	---	CANCELLED
15:00	MILAN	---	CANCELLED
16:25	KYIV	---	CANCELLED
16:55	MOSKOW	---	CANCELLED



TOP NANO – Nordic project with funding from industry and the Top-level Research Initiative

www.topnano.se

Keep aircraft, wind turbine blades and heat exchanger surfaces free from ice and contaminants using nanotechnology surface coatings



Duration 2010-2014

Grant from Top-level Research Initiative. Total project budget 35 MSEK

Research partners

YKI (SP) and KTH: Surface chemistry expertise

VTT: Ice physics expertise

Aarhus University: Surface grafting expertise



Industrial partners

Companies from aircraft, wind power, heat-exchanger industry and coating companies



Aim: Utilizing Nanotechnology to create surfaces where ice formation is reduced

Optimization of surface chemistry and surface topography on the nanometer scale to delay ice and condensation formation.

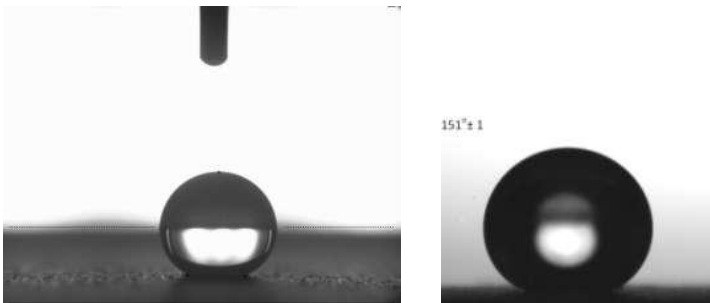


Approaches



The lead ideas to reduce ice formation are:

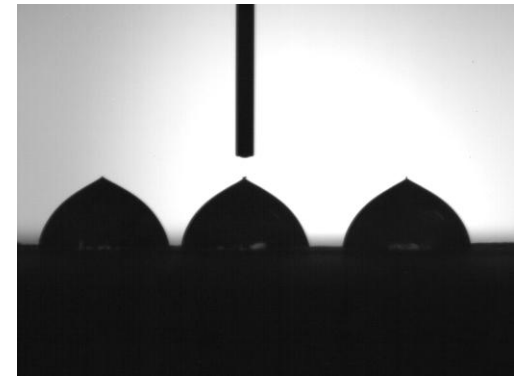
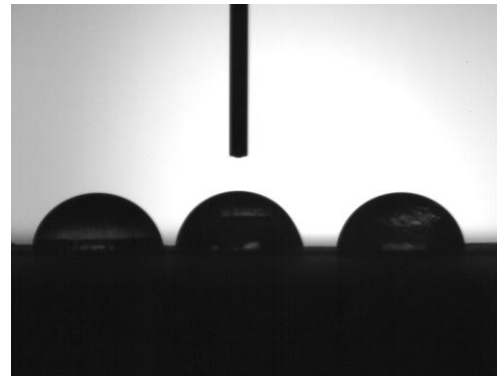
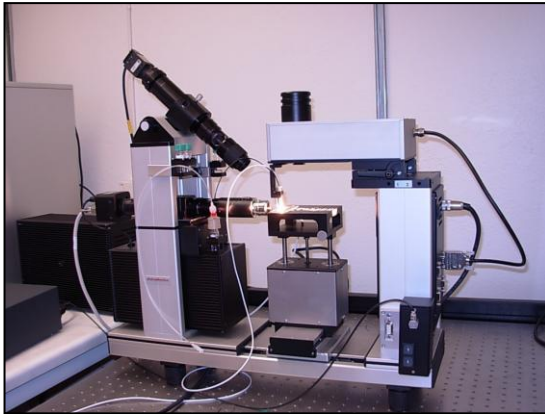
- use of superhydrophobic surfaces
- use of surfaces exposing chemical groups that are classified as water-structure breakers
- to understand on a molecular level why or why not these concepts work



New methodologies – Contact angle device

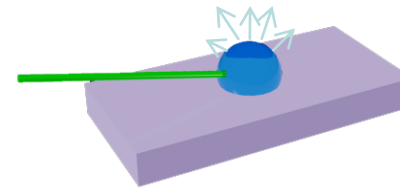
- The sample can be cooled down to -20°C
- Heating/cooling device for temperature control (-10°C to $+90^{\circ}\text{C}$) of dispensed droplets
- Thermosensors for simultaneous monitoring of the temperature in the air, droplet and at the surface
- Climate chamber under construction

Study of water droplets freezing

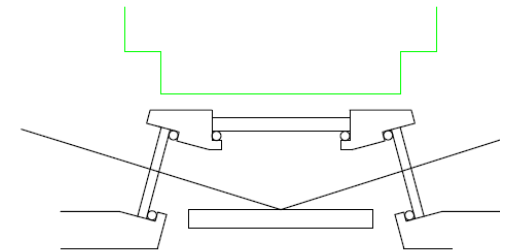
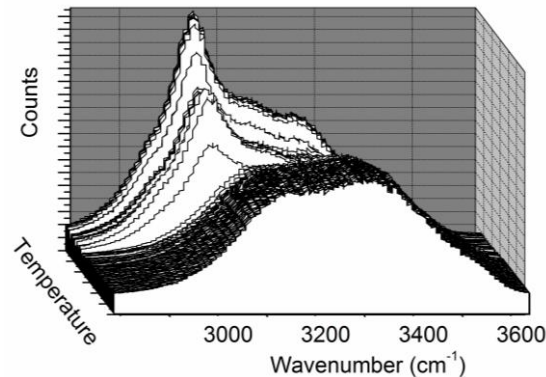
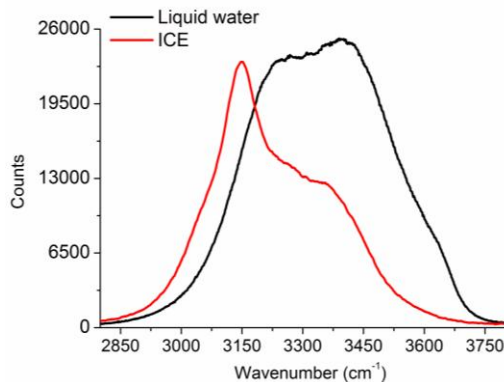


Spectroscopic methods

- Accurately determine when water freezes under equilibrium and dynamic conditions (millisecond time scale)
- Evaluate the formation of frost
- Determine the degree of supercooling
- Effects of ions and functional groups

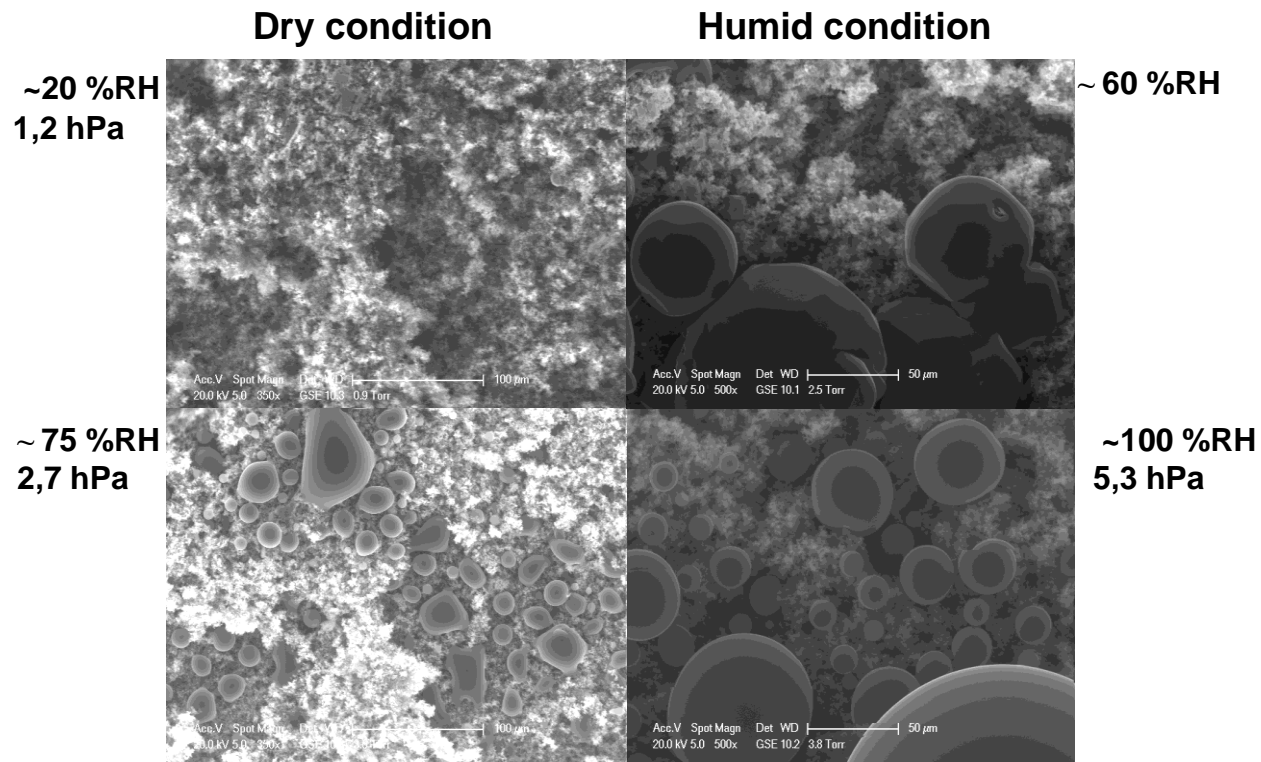


Exploratory tests provide proof of principle:



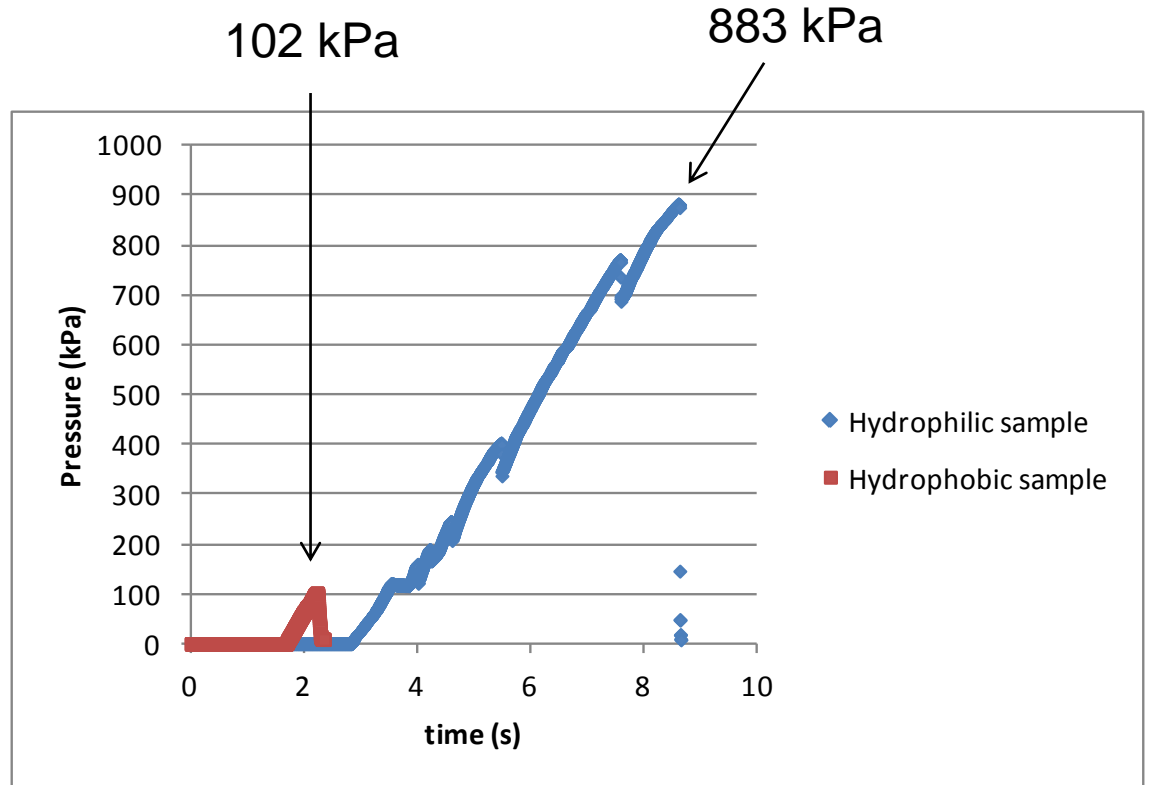
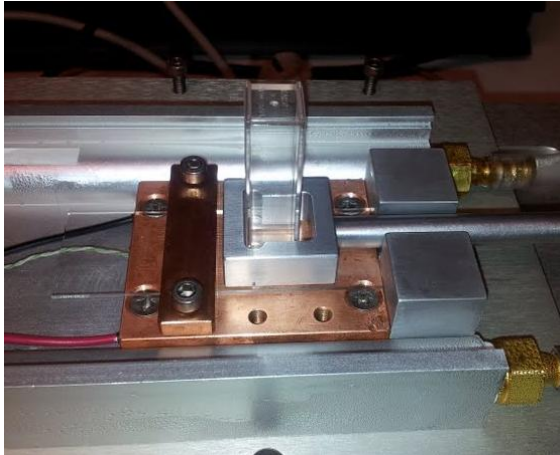
E-SEM – Environmental scanning electron microscopy

- Frost formation on a sample by changing the chamber pressure at subzero temperatures.
- The setup has been improved for creating HD movies



Ice adhesion measurements

The force to remove a frozen ice pillar from a sample is monitored



Upcoming events

2nd Annual TopNANO seminar on nanotech for deicing, Nov. 2012

Public seminar with invited speakers

A follow-up on the 1st Annual TopNANO seminar on nanotech for deicing, which was held Nov. 8, 2011

Topics:

- New insights in ice and frost formation using advanced spectroscopy
- Aspects of ice formation and adhesion
- How to mimic nature to avoid ice accretion
- Pros and cons of superhydrophobic coatings in deicing
- Laminar-flow liquid-to-air heat exchangers – energy-efficient display cabinet applications
- Managing ice and frost issues in wind turbine applications

Summary

- TopNANO – A Nordic research project coordinated by YKI where nanotechnology is utilized to solve the problem with ice
- Industrial partners from different application areas: wind power, aircraft and heat-exchanger
- A wide range of methodologies are used to increase the understanding of how different surface properties affect the formation of ice

Meet us at the booth at the exhibition!