



# A fast test for toxic nanoparticles

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CheckNano is funded by the European  
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**Interreg**  
Deutschland - Danmark



Our partners



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## The challenge

- Nanoparticles with size below 100 nm are used in various industries for product enhancements
- Below a critical size limit, NPs cross cell membranes → possible cell death
- New standards need control of size → fast, integratable test for such NPs necessary

## Our aim

- Ultra-compact fast test prototype for toxic nano-particle detection
- Nano filters for particle pre-filtering

## Our approach

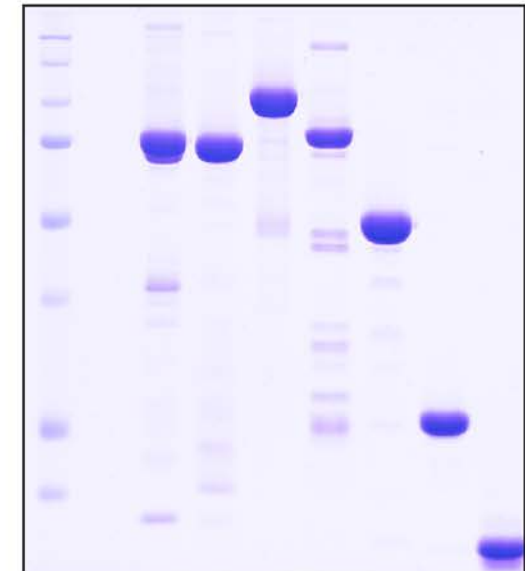
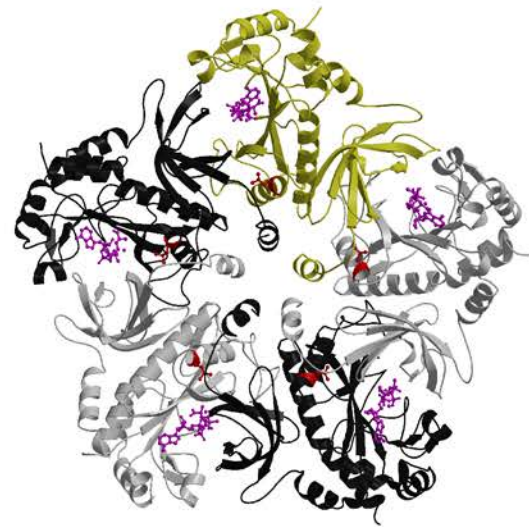
- Microfluidic chip platform with integrated laser unit
- Specifically designed nano filters and particle trapping concept



## Nanoparticles – Biological Matrix



From Organism  
to Molecular  
Level

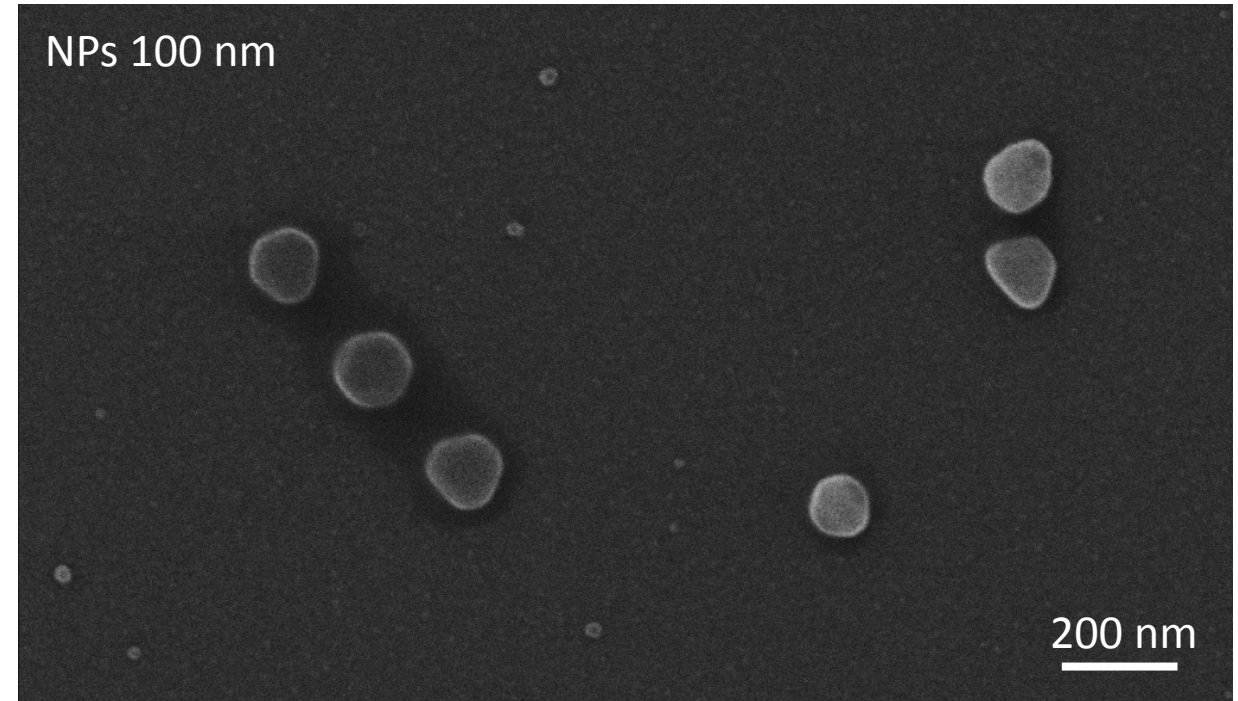




## Laser-based Particle Discrimination

- Optical detection of “trapped” (toxic) NPs
- Based on (optical) particle resonance and its electronic analysis
- On-chip laser integration

Technology

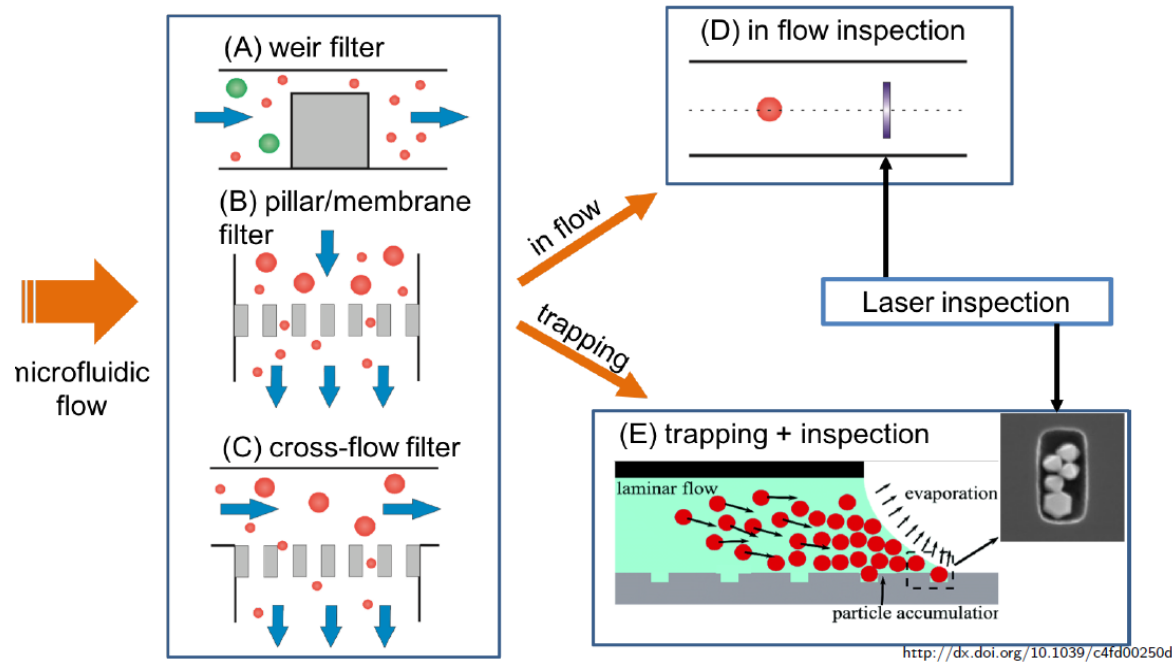


Particles of different sizes in the nano regime have different optical responses depending on their size.

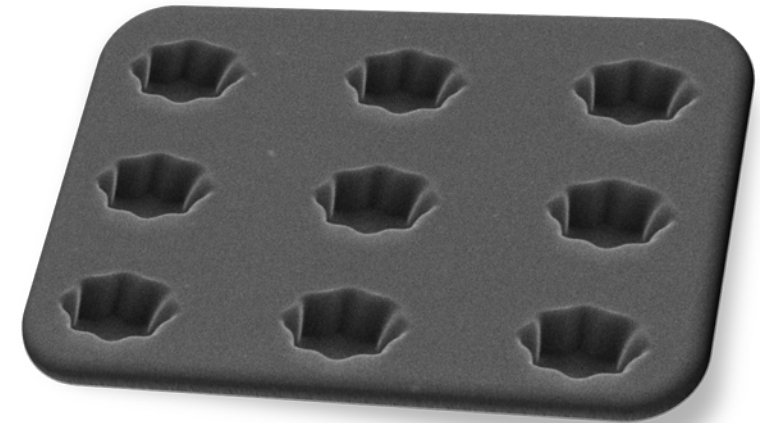
Sample of commercially available silver NPs of size 100nm contain particles down to 20 nm.

# Capillary Assisted Particle Assembly (CAPA)

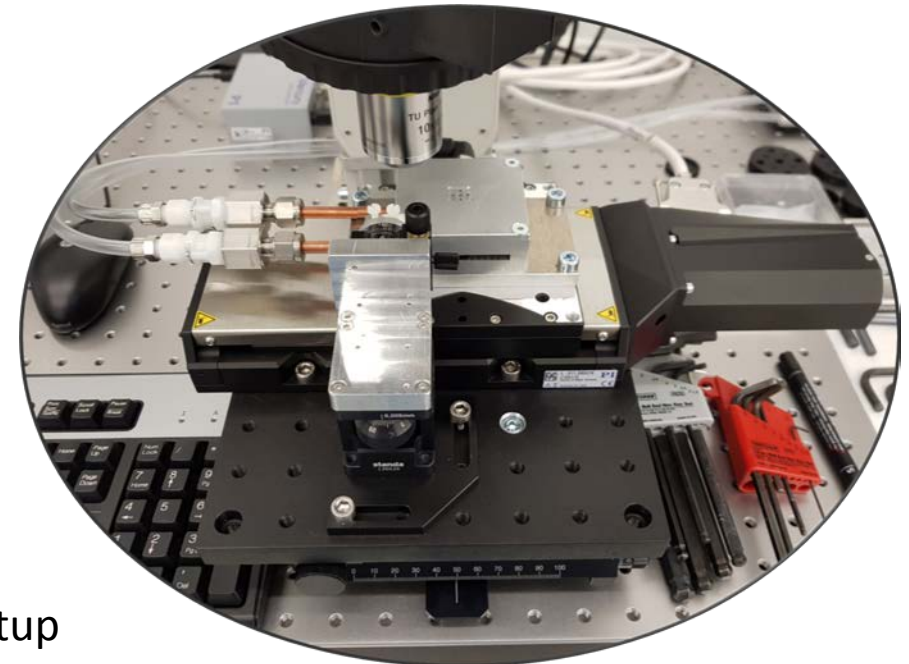
Technology



Filtering in a particle trap.



NP filter

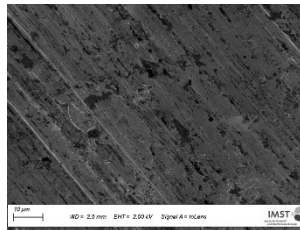


Lab setup

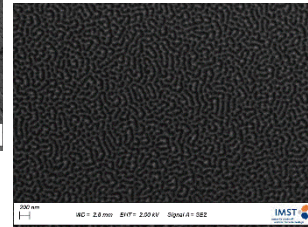
# Process steps for nanofilter fabrication

## Nanofilters

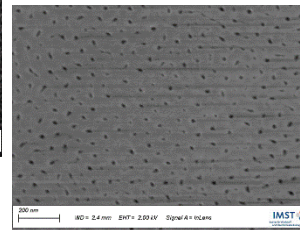
**Temperature:** 500 °C  
**Atmosphere:** Argon  
**Time:** 4 h



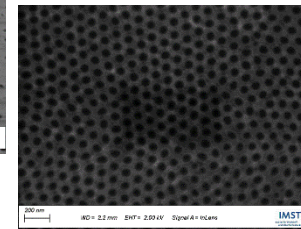
**Temperature:** 23 °C  
**Voltage:** 30 V  
**Time:** 30s  
**Solution:**  
6% HClO<sub>4</sub> in 99% Ethanol



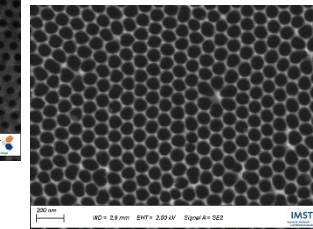
**Temperature:** 10 °C  
**Voltage:** 40 V  
**Time:** 60 min  
**Solution:**  
0.3 M Oxalic Acid in water



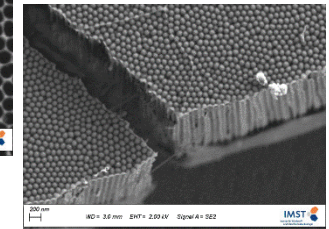
**Temperature:** 70 °C  
**Time:** 60 min  
**Solution:**  
Mixture of 6 wt% Phosphoric acid & 1.8 wt% Chromic acid, in water



**2nd Anodization:**  
**Temperature:** 10 °C  
**Voltage:** 40 V  
**Time:** 60 min  
**Solution:**  
0.3 M Oxalic Acid in water  
**Pores widening:**  
**Temperature:** 30 °C  
**Time:** 30 min  
**Solution:**  
5 wt% Phosphoric acid in water



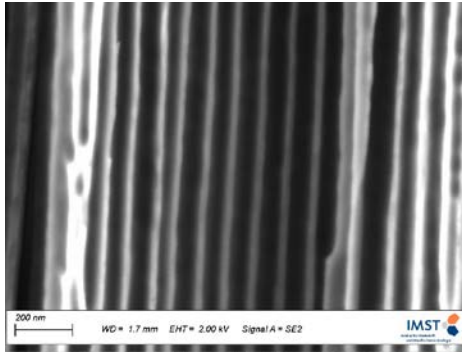
**PMMA spin-coating:**  
**Temperature:** Room Temperature.  
**Time & speed:**  
1) 8s, 800 rpm  
2) 20s, 3000 rpm  
**Solution:**  
10 wt% PMMA in acetylacetone  
**Drying:**  
**Temperature:** 80 °C  
**Time:** 3 h  
**Al dissolving:**  
5.2 wt% HgCl





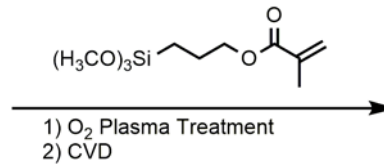
# Filter Function- alization

Nanofilter  
cross-section

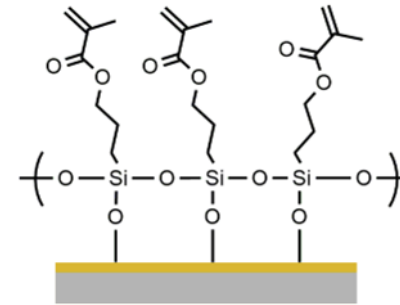


## Process steps for nanofilter functionalization with hydrophilic, thermoresponsive polymer brushes

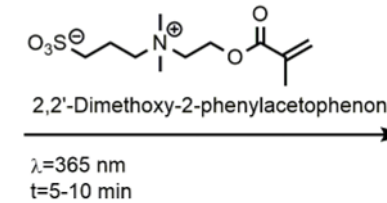
Primer-  
attachment



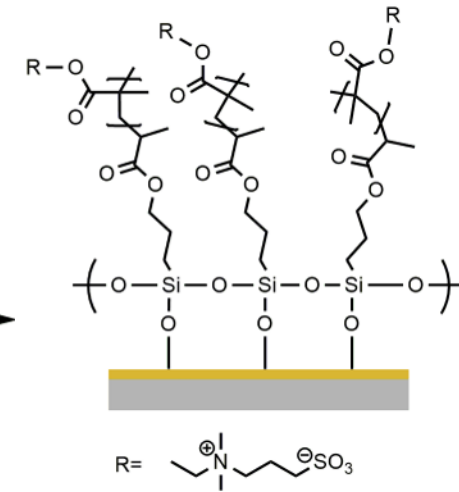
Primer on  
pore walls  
and surface



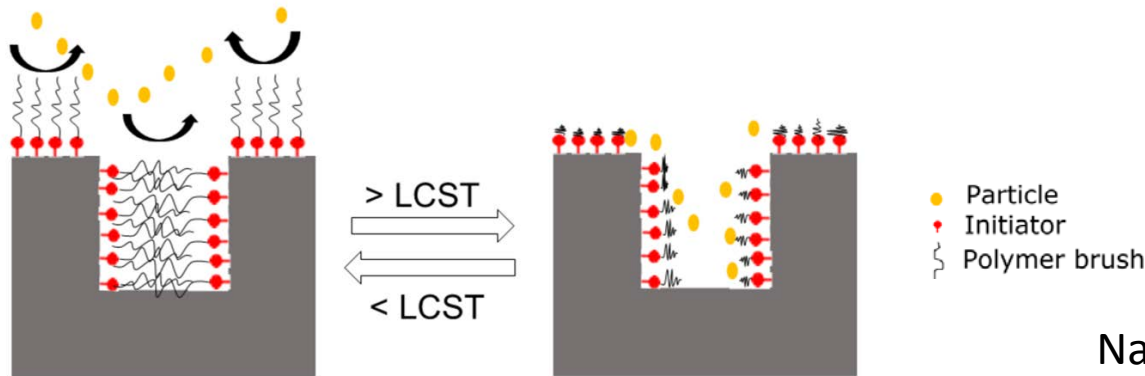
Initiator  
attachment



Photopolymerization  
Of polymer brushes



Nanofilter functionalized with  
thermoresponsive polymer brushes



Nanoparticles are trapped below the lower critical solution temperature (LCST) and released above it

We combine interdisciplinary competences in nano technology, bio-  
and food technology and sensor technology of the German-Danish  
border region



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