Room 2

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Analytical and Characterisation Excellence

Christoph SCHLAGER – VITROCELL	*Miniaturisation of an air-liquid interface simulator for fast assessment of cellular nanomaterial toxicity*
Florian MEIER – POSTNOVA	*Harmonised sample introduction pre-treatment for nanomaterial suspensions*
Loïc BURR – CSEM	*Hydrophobic interaction chromatography for a novel nanomaterial hydrophobicity assay*
David SCHMID – CSEM	*Microfluidic device to enable fast & reproducible assays, such as for reactivity and dissolution assessment*
Jörg RADNIK – BAM	*Optimal sample preparation for characterization of nanomaterials in either solid or suspended form*

Moderation: Mikko RISSANEN

Transcript: Sophie BRIFFA

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nanoSAFE'20

Developments of VITROCELL

- Main objective: Miniaturisation of existing Automated Exposure Station

Developments of VITROCELL

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- Six positions for the exposure of cell cultures inserts (12-Well format)
  - Three times clean air, three times aerosol
- Two positions for analytical purpose
  - Can be equipped with QCM, TEM or confocal microscopy sample holder
- Miniaturisation of existing Automated Exposure Station leads to:
  - New flow control concept for exposure modules and main flow
  - New control concept for humidification process
  - New heating unit for a more even heating of the system
  - Development of new analysis sample holders inside exposure modules for later evaluation at TEM and confocal microscopy

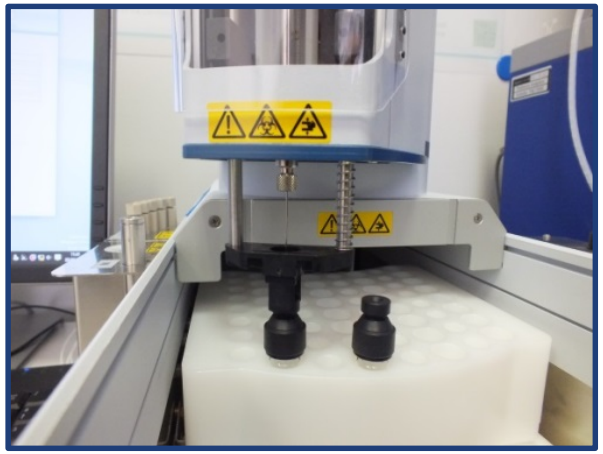
Automated preparation of nanoparticle samples using the SP2000 NOVAPREP – Nano Particle Sample Preparator

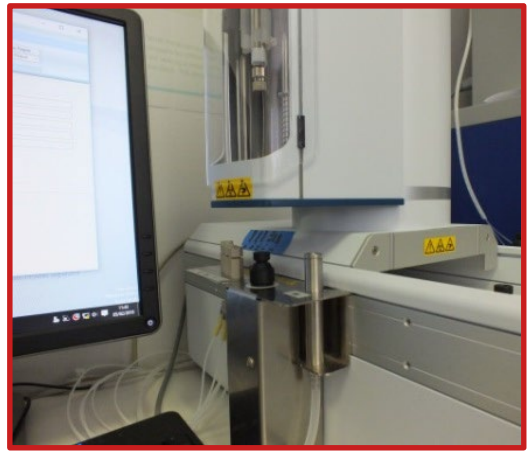
Robot-based station for a reliable and reproducible preparation of liquid nanomaterial suspensions based on software supported SOPs

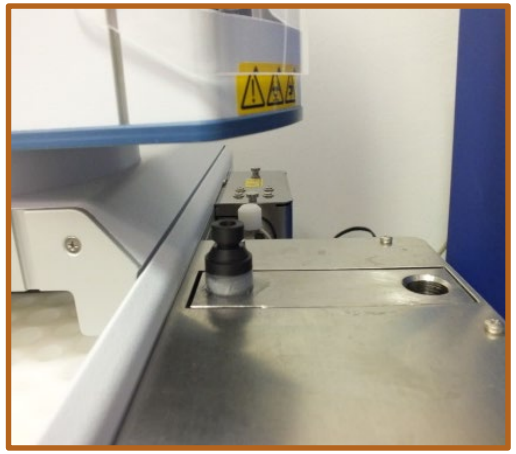
Dr Florian Meier
Group Leader Research
Postnova Analytics GmbH

SP2000 NOVAPREP

Capabilities







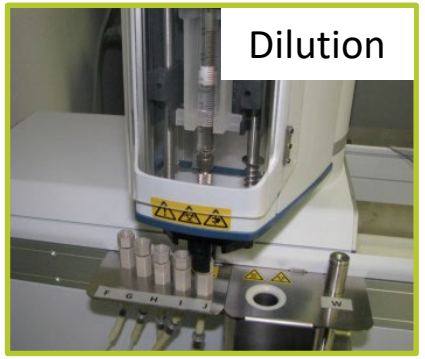
SP2000 NovaPrep Options:

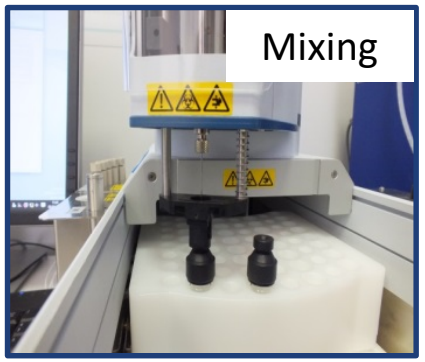
- Dilution
- Mixing
- Vortexing
- Sonication
- Filtration
- Injection

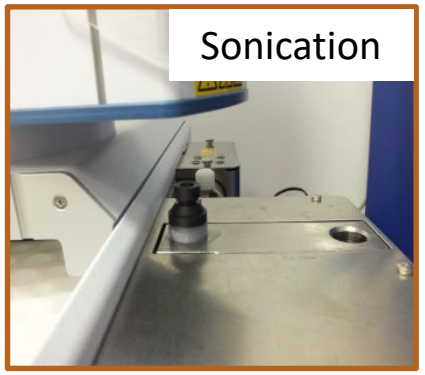
SP2000 NOVAPREP

TiO_2-NM104

- Nanopowder







Size determination of TiO_2 particles via DLS and AF4-UV-MALS measurements (n=3)

DLS	AF4-UV-MALS
D_h (nm)	R_g (nm) at UV_{max}
189 ± 4	**62 ± 3**

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SP2000 NOVAPREP

POSTNOVA

Pitch me up!

- Robot-based system
- Highest flexibility
- Dedicated software-based SOPs
- Excellent repeatability and reproducibility
- Operator-independent
- Time- and cost-saving
- Interfaceability with common nano-characterization instruments such as FFF

Enhancing confidence in nanomaterial sample preparation and characterization!

Standard Operating Procedure

Nanotechnology – Automated preparation of a dilution series from an Aerodisp® W 740 X TiO_2 stock suspension using the Postnova "SP2000 Nano Particle Sample Preparator"

Standard Operating Procedure

Nanotechnology – Automated preparation of a stable suspension from TiO_2 powder (TiO_2-NM104) using the Postnova "SP2000 Nano Particle Sample Preparator"

Standard Operating Procedure

Nanotechnology – Automated preparation of a stable suspension of PVP-coated TiO_2 particles using the Postnova "SP2000 Nano Particle Sample Preparator"

Microfluidic platform for nanomaterials risk assessment

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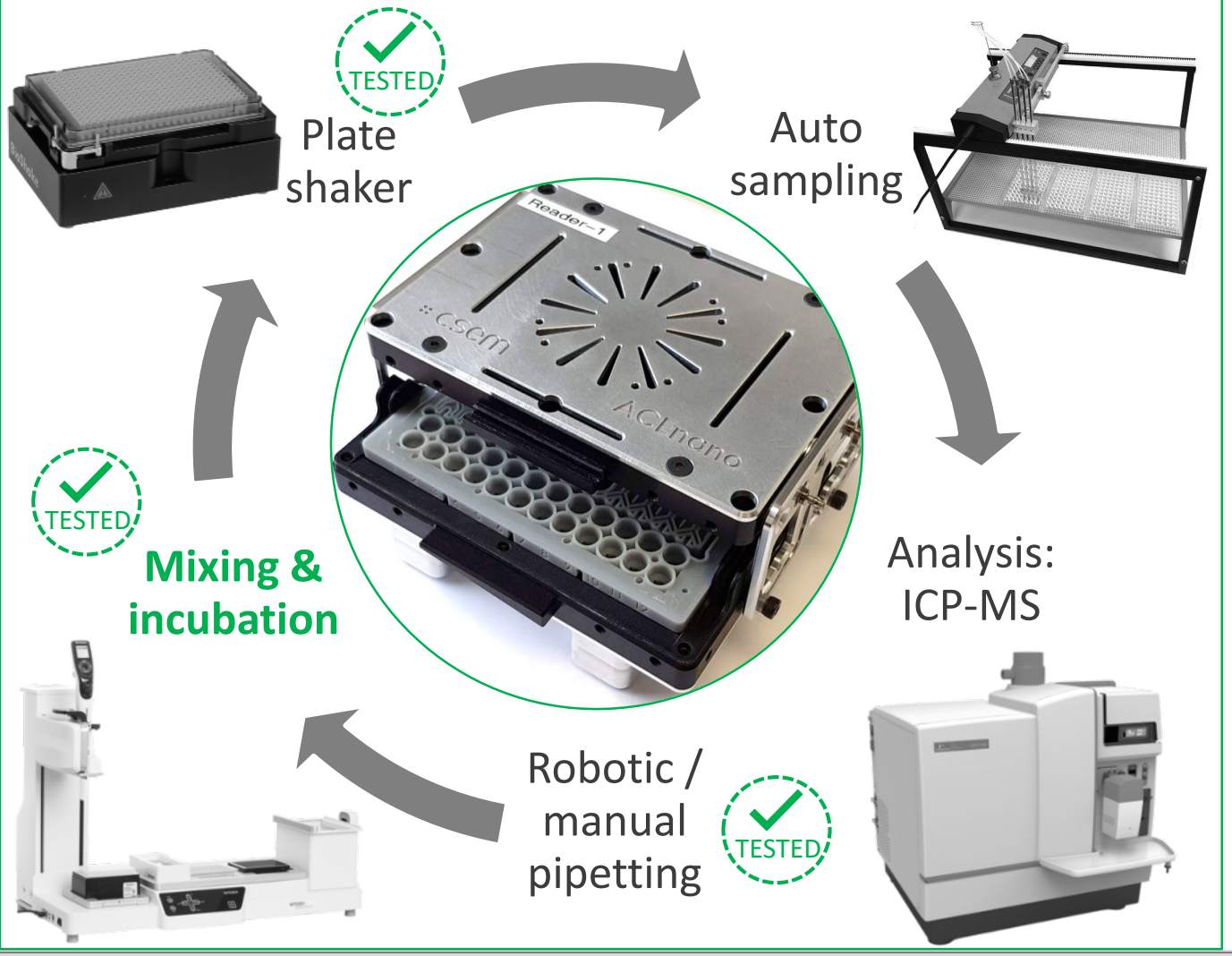
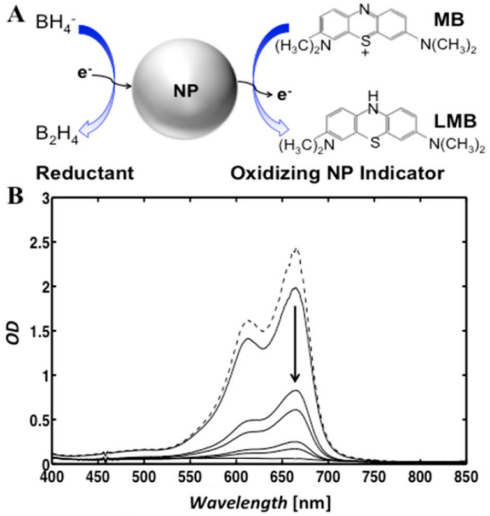
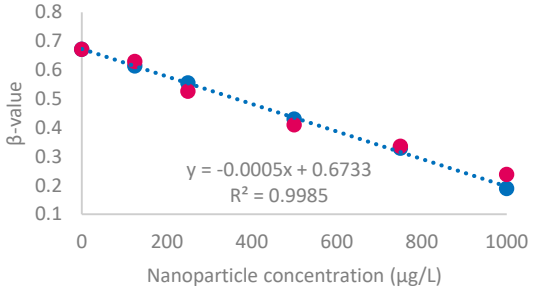
Solubility sample preparation



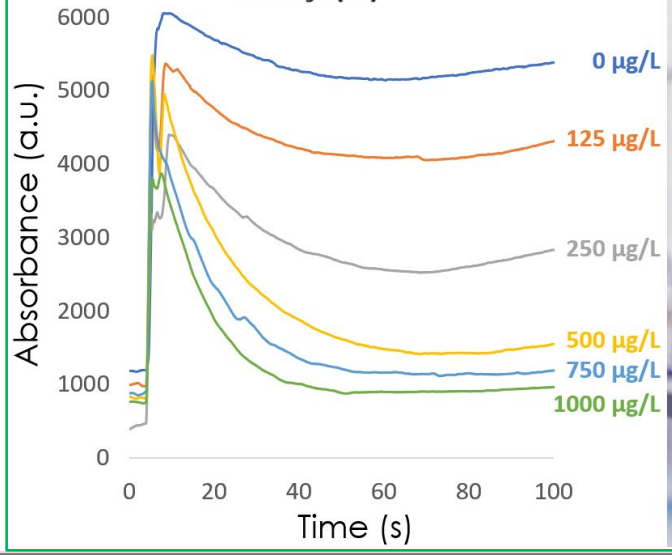
Catalytic reactivity



NP catalyst reduces the dye methylene blue -> Change in absorbance



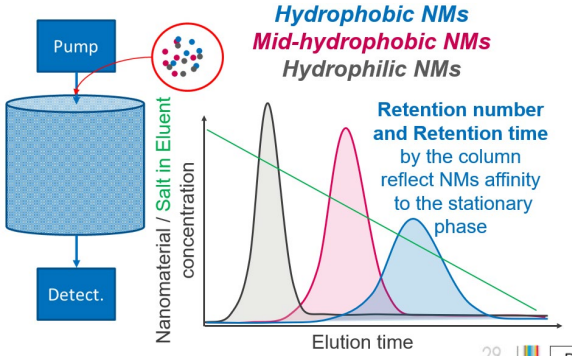
Screen for NP presence or quantity



Direct assessment of nanoparticle hydrophobicity

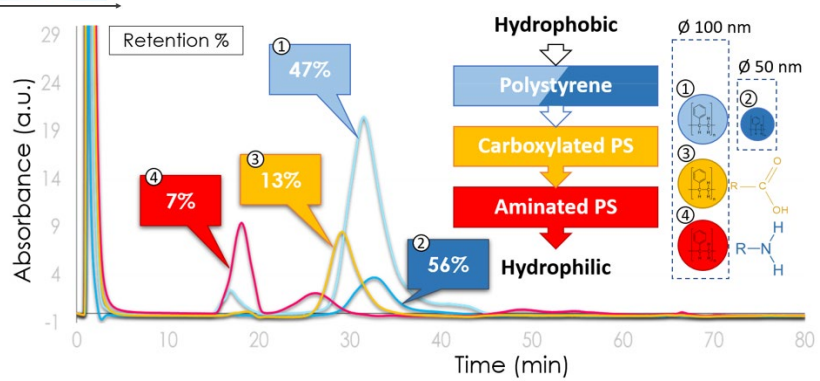
HIC: Hydrophobic Interaction Chromatography

00876: 100 nm – bare PS 08691: 50 nm – bare PS 16588: 100 nm – PS + amine surface groups 16586: 100 nm – PS + carboxylate surface groups

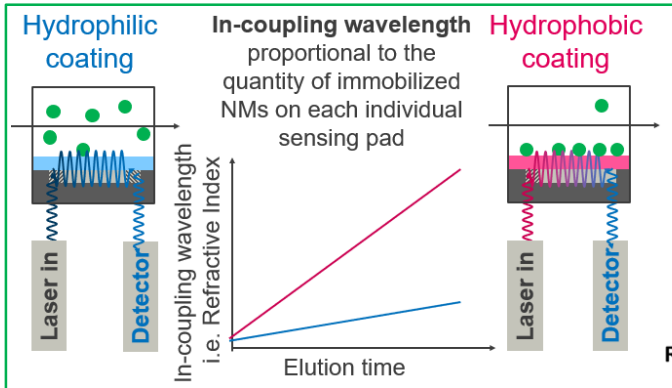


Separate NMs based on their reversible adsorption, according to their hydrophobicity

Retention on the phenyl functionalized column correlating with particle hydrophobicity



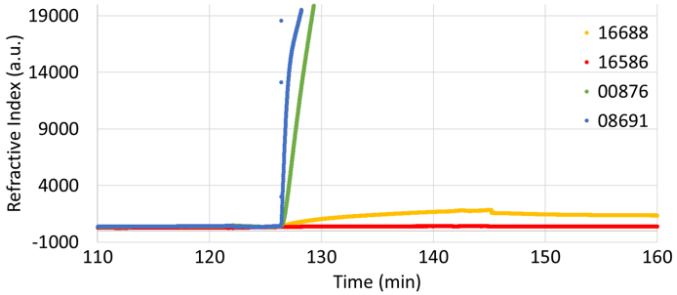
BI-WIOS: Binding Affinity – Waveguide Interrogated Optial System



Assess the adsorption of NM on surfaces with defined hydrophobicities by measuring the change of refractive index on the surface

Adsorption on Teflon functionalized waveguides correlating with particle hydrophobicity

Refractive index changes induced by sample injection on Teflon coated waveguides



Conclusion & Outlook: HIC & BA-WIOS adequate for hydrophobcita assessment of Latex NP

Hydrophobic → 00876 / 08691 Polystyrene → 16688 Carboxylate → 16586 Amine → Hydrophilic

Challenge: Regeneration & re-use of the column and waveguide (**cost driver**)

Preparation from powder

Advantages:

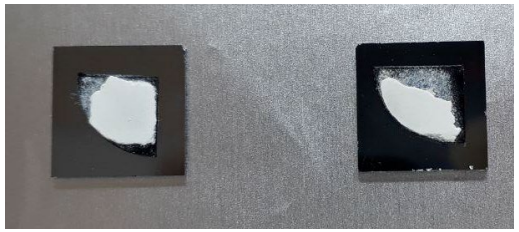
⊕ NPs in pristine state
⊕ No contact with other materials

Disadvantages:

⊖ No possibility for cleaning/purifying sample

Stick and go

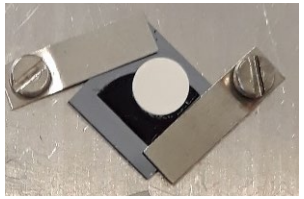
⊕ Fast and easy
⊖ Danger of NP release into instrument



Pellets

⊕ Reduced danger of NP release into instrument
⊕ Allows sputtering – analyse bulk material

⊖ May introduce contamination
⊖ NPs may be damaged by high pressure
⊖ Requires larger amount of sample



Preparation from dispersion

Advantages:

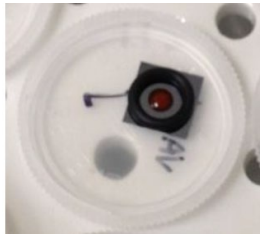
- ⊕ Allows purification /cleaning steps
- ⊕ Control of sample thickness

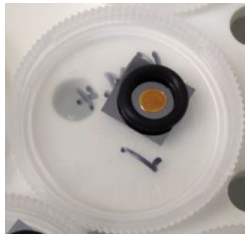
Disadvantages:

- ⊖ May introduce contamination
- ⊖ May destroy sensitive coatings

Drop-casting

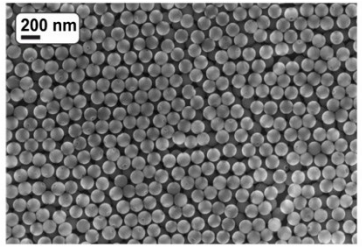
- ⊕ Simple and inexpensive
- ⊖ Time consuming



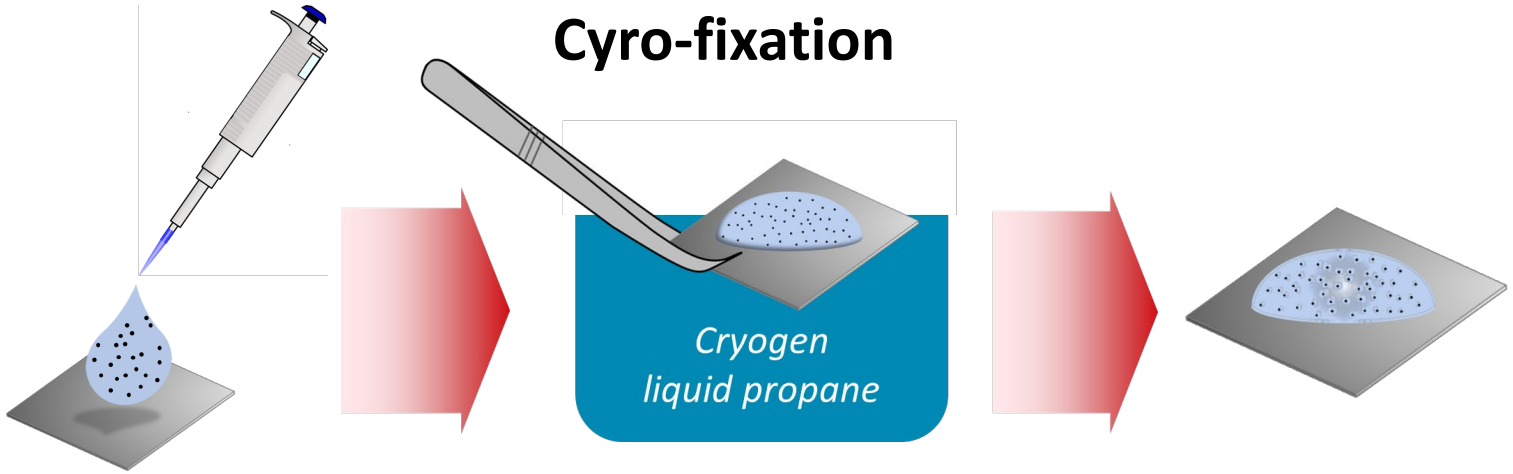


Spin-coating

- ⊕ Thin controllable layer, suitable for non-conductive particles
- ⊕ Highly reproducible
- ⊖ Inhomogeneities from dust / aggregates



Cyro-fixation



- ⊕ Conserves morphology, native biological state and NP corona
- ⊕ Reduces coffee ring effect
- ⊕ Reduces impurities

- ⊖ Complicated and expensive equipment
- ⊖ Requires skilled user

Bennet, F., Müller, A., Radnik, J., Hachenberger, Y., Jungnickel, H., Laux, P., Luch, A., Tentschert, J.
Preparation of Nanoparticles for ToF-SIMS and XPS Analysis. J. Vis. Exp. (163), e61758, doi:10.3791/61758 (2020).