

# BNN Gold Member Webinar

31 May 2022  BNN

Process Analytical Technologies for  
Industrial Nanoparticle Production

Ing. Dr. Christian HILL, MA



NANOPAT:



# Medical University Graz



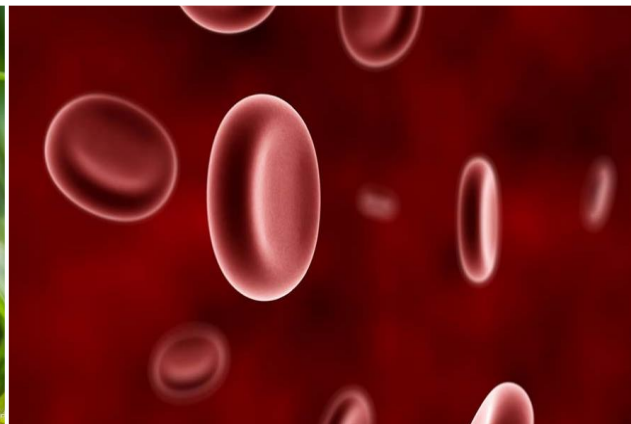
# Real-time nano-characterisation technologies (RIA)



...characterisation protocols ...  
of faster methods...  
suitable (for) online or inline  
use in the factory...

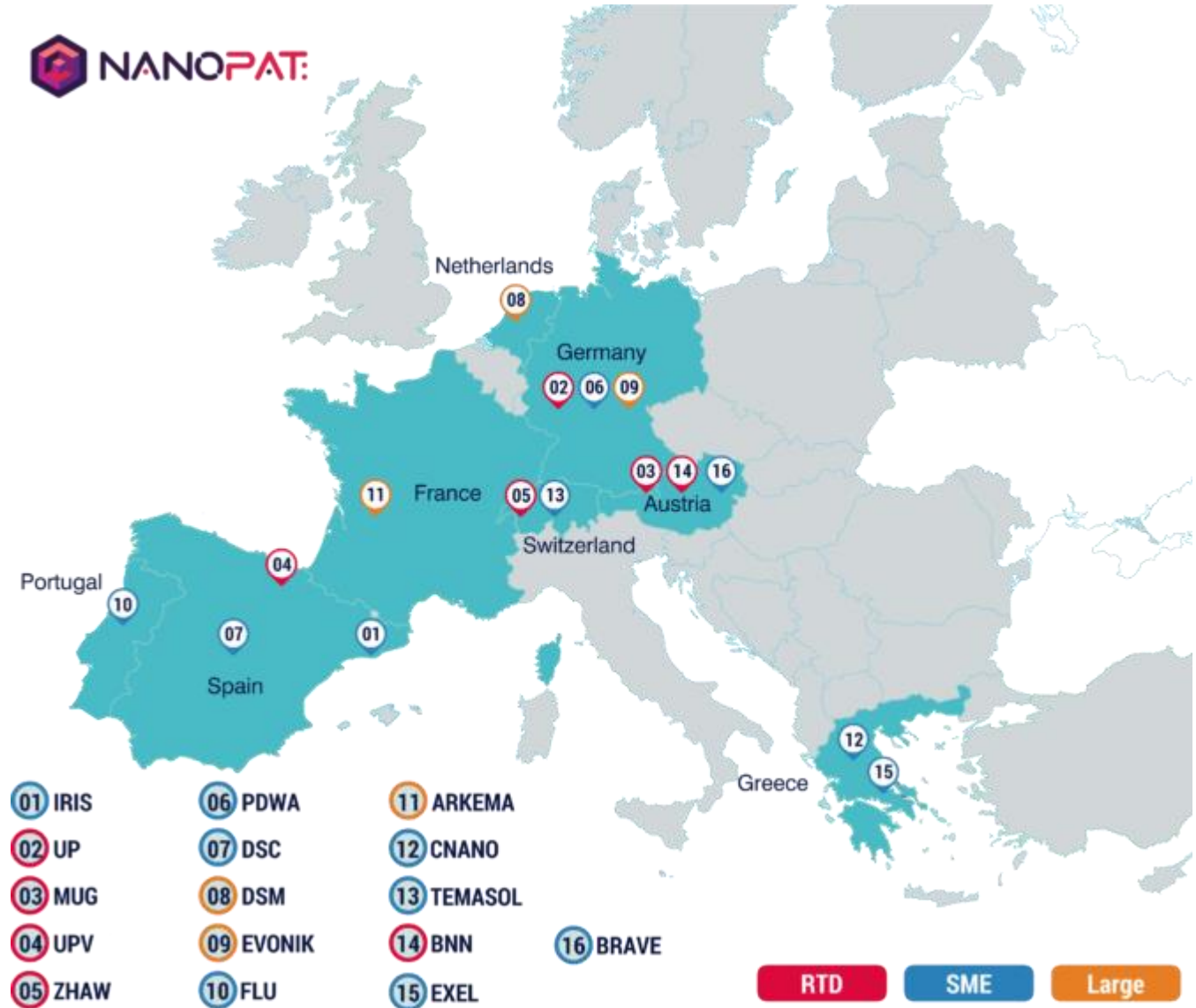


H2020\_DT-NMBP-08-2019: [Real-time nano-characterisation technologies \(RIA\) | Programme | H2020 | CORDIS | European Commission \(europa.eu\)](#)



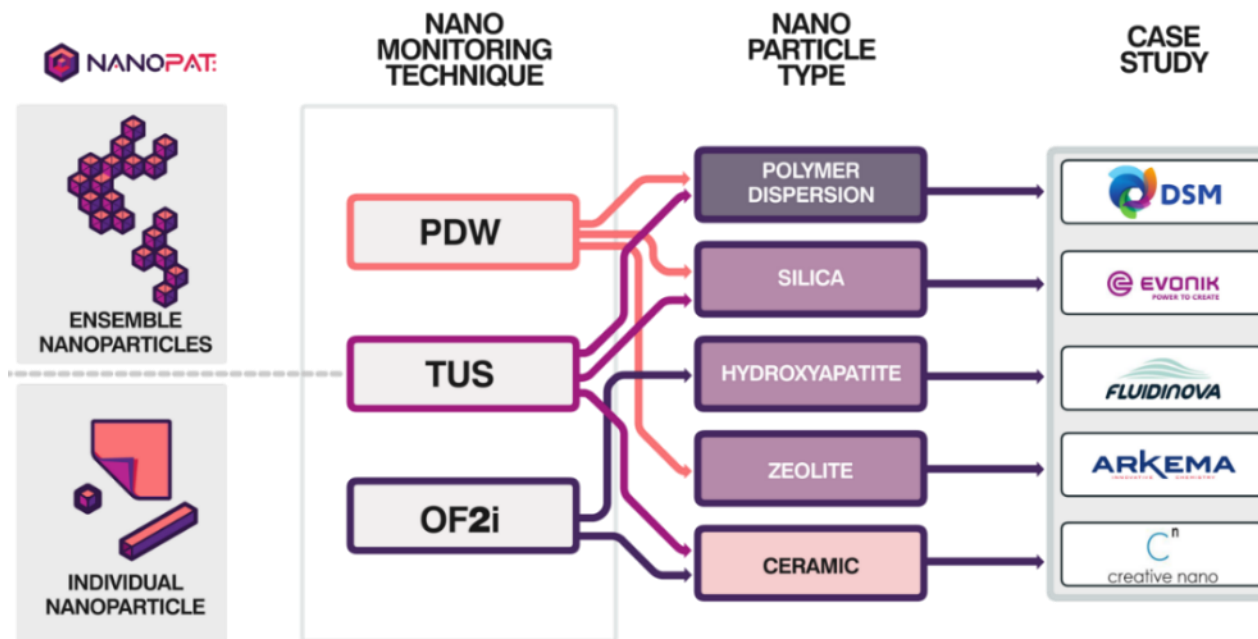
# Consortium

- 8 countries
- 16 partners
  - 5 RTO's
  - 8 SME's
  - 3 Large's
- Coordinator: IRIS
- Technical Management: UP
- Budget: €4.968.508,79
- Duration: 4 years



# Scope of the project:

... to deliver three novel, real-time nano-  
 characterisation Process Analytical  
 Technologies (PAT)



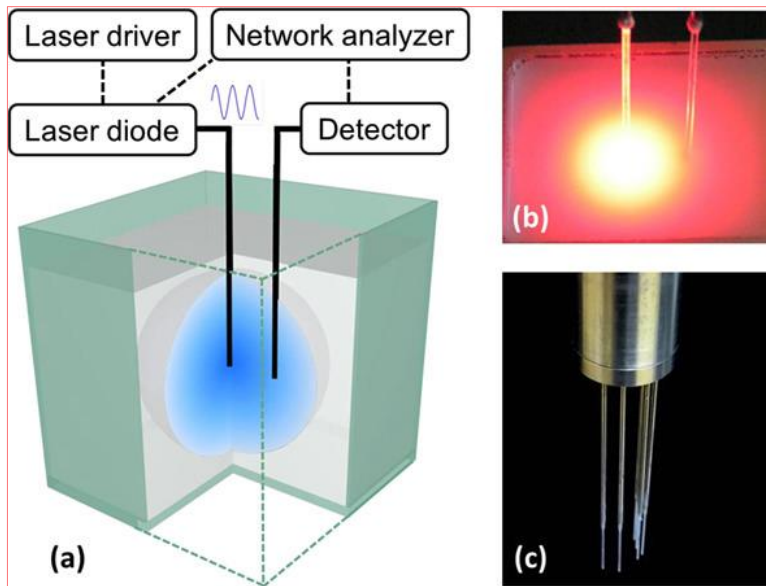
Photon Density  
 Wave spectroscopy (PDW)

Turbidity  
 spectrometry (TUS)

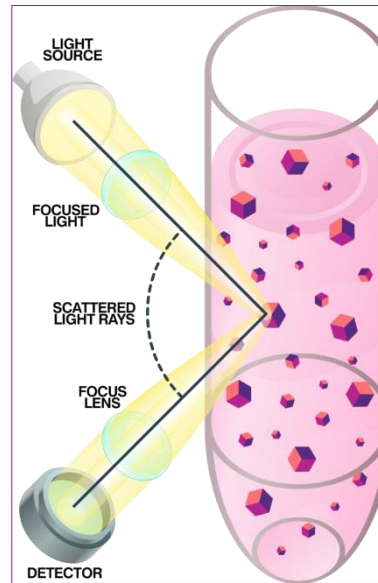
OptoFluidic force  
 induction (OF2i)

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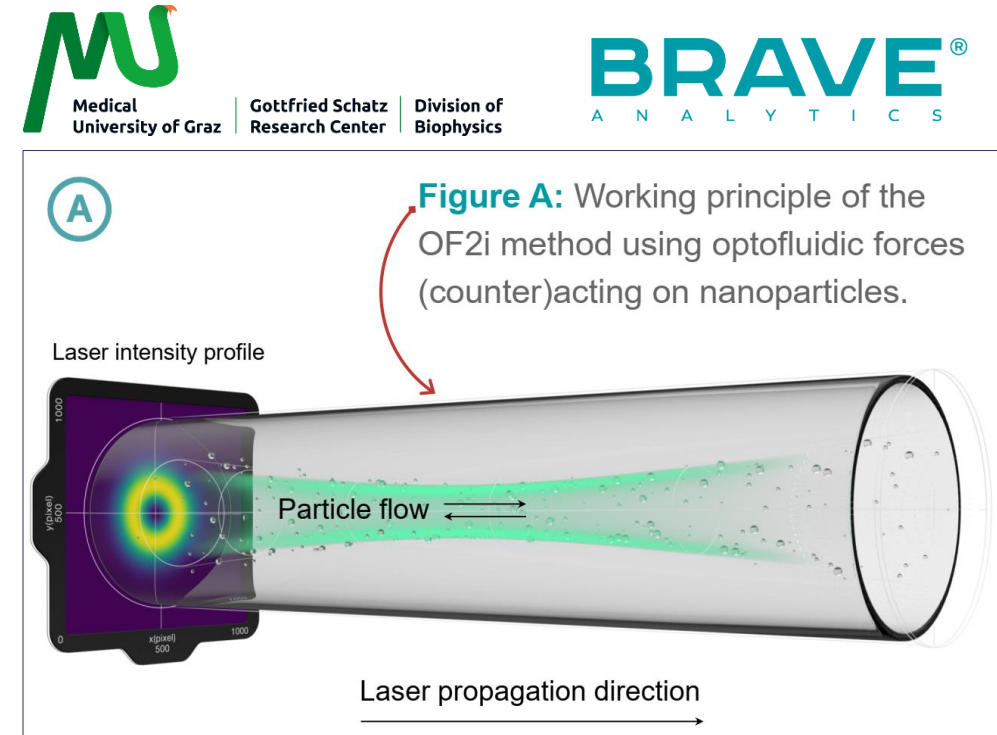
... to deliver three novel, real-time nano-characterisation Process Analytical Technologies (PAT)



Photon Density  
Wave spectroscopy (PDW)



Turbidity  
spectrometry (TUS)



OptoFluidic force  
induction (OF2i)

# Advanced monitoring system



## Silica (Partner Lead: EVONIK)

Real-time in-situ monitoring of the genesis of nanostructured silica under different precipitation conditions.



## Hydroxyapatite (Partner Lead: FLUIDINOVA)

Nanohydroxyapatite particle size characterization using online OptoFluidic force induction (OF2i) technology.



## Ceramic (Partner Lead: Cnano)

Monitoring of ceramic nanoparticle suspensions in pilot scale production of nanocomposite coatings.



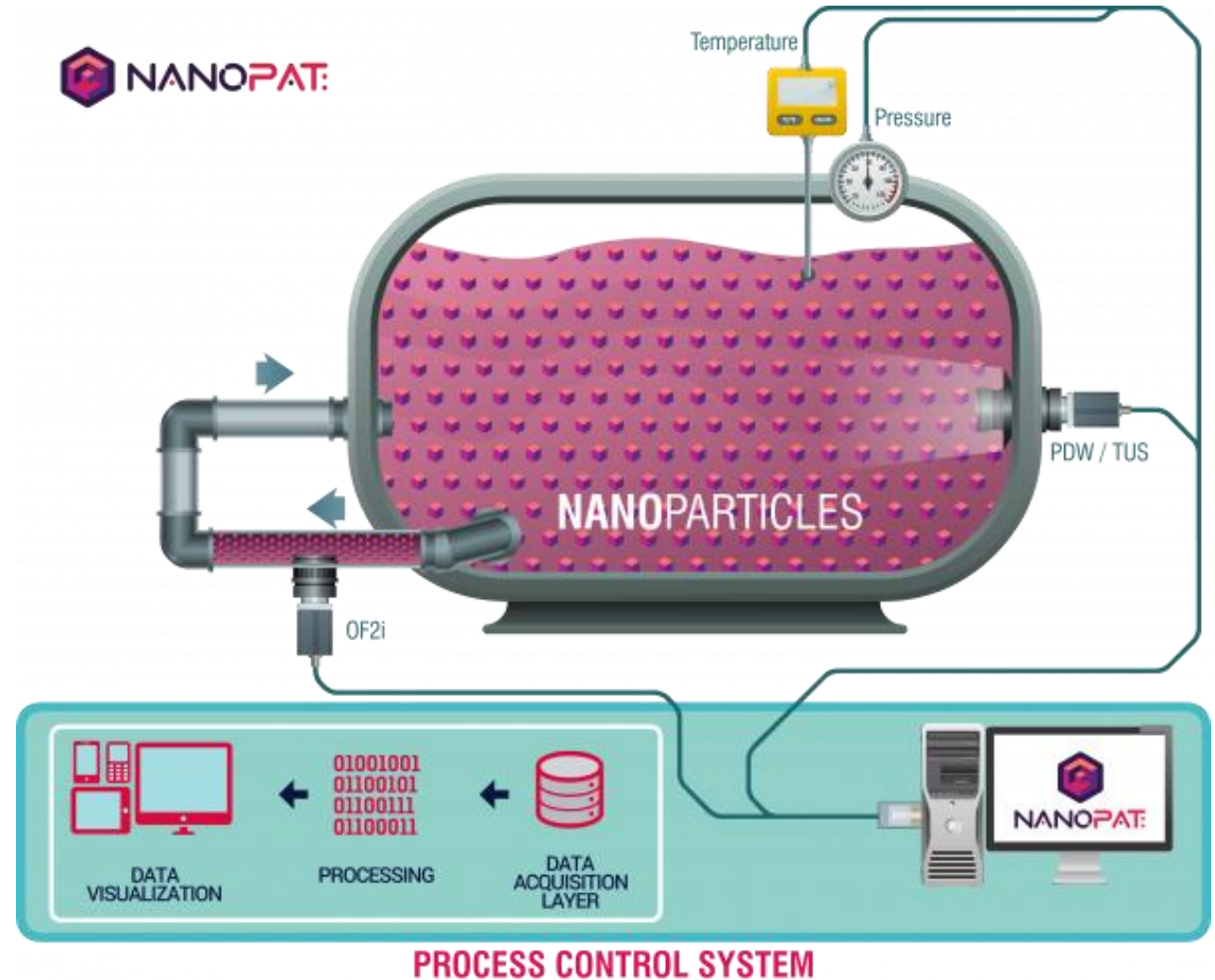
## Zeolite (Partner Lead: ARKEMA)

Continuous inline characterization for the manufacturing of zeolites in batch and continuous systems.



## Polymers (Partner Lead: DSM)

Monitoring Particle Formation of Polyurethane dispersions and Polyacrylate emulsions.





# BRAVE

A N A L Y T I C S

Basic Research

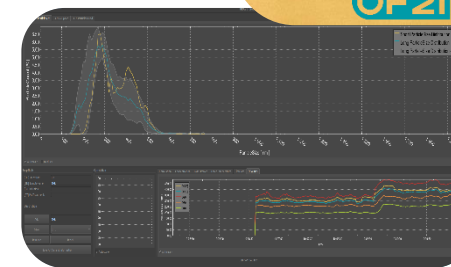
Validation

Translation



OF2i

real time PAT  
PROCESS  
ANALYTICAL  
TECHNOLOGY



B2 Lab Device



# OF2i PRINCIPLE

*...breaking the barrier of Brownian Motion  
with actively induced optical and fluidic forces...*



# Electrodeposition of Ni-SiC nano (composite) pulse plating coatings

NiP coatings produced by electrodeposition have important mechanical, tribological and electrochemical properties. Co-deposition of particles, the influence of bath hydrodynamics, ultrasonication and control of operational parameters are monitored by OF2i

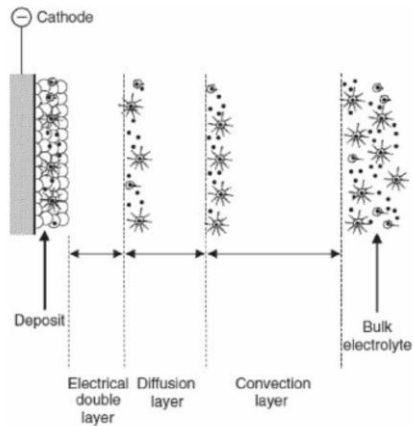
Ni-P/SiC electrolyte solution with corresponding temperature control, pH measurement and ultrasonication



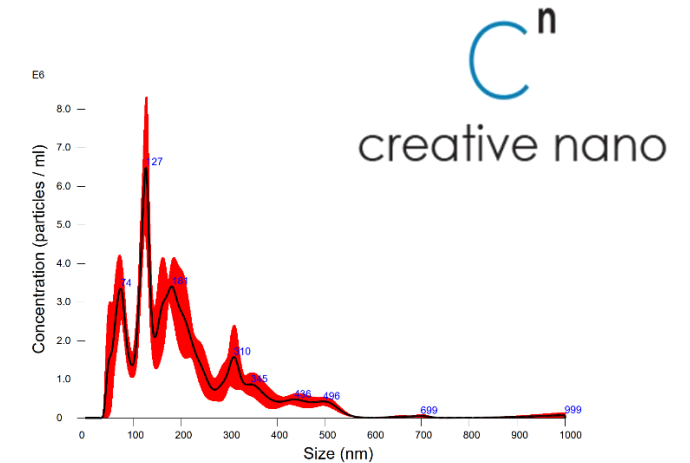
Katerina Mavronasou, MSc



group of Dr. Alexandros Zoikis Karathanasis, MSc CEO of CREATIVE NANO for nano-powered innovations in automotive, constructions, aerospace, healthcare, food



- Particles (conductive or non conductive)
- Surfactant (ionic, non-ionic or organic)
- ✱ 'Clouing' of particles by surfactants
- ⊕ 'Clouing' of particles by cations
- Deposited metal



SiC-SDS (100mg/25mg) NP-suspension, NTA reference size distribution

Preliminary, unpublished data in cooperation with  creative nano

I. Lelevic, et al; Electrodeposition of NiP composite coatings: A review, Surface and Coatings Technology, Volume 378, 2019, 124803, ISSN 0257-8972, <https://doi.org/10.1016/j.surfcoat.2019.07.027>.

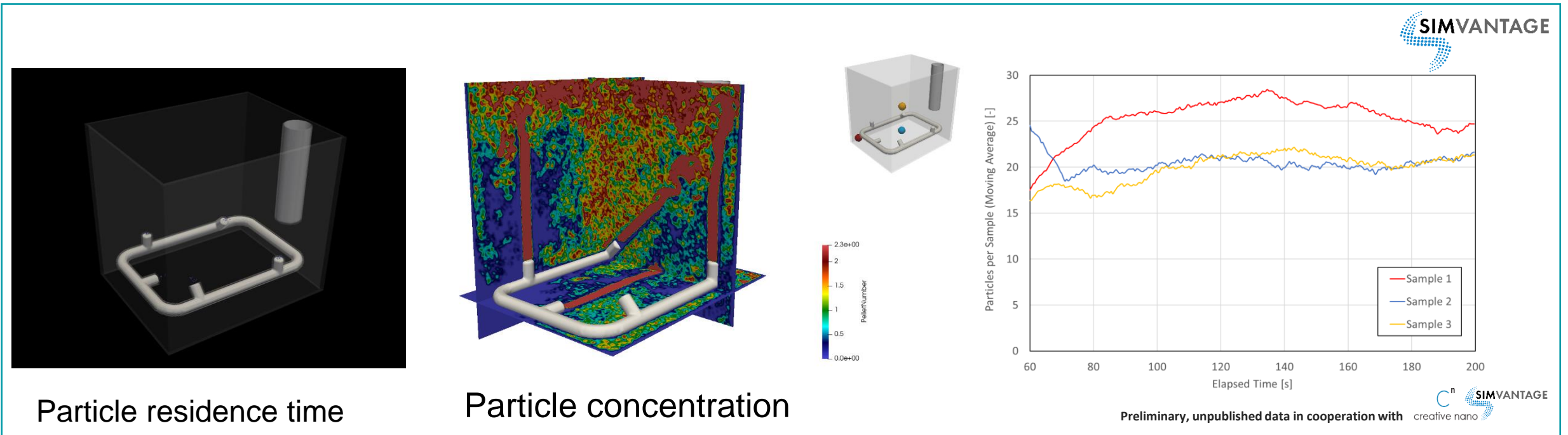
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DI Dr. Christian Witz  
CEO SIMVANTAGE GmbH

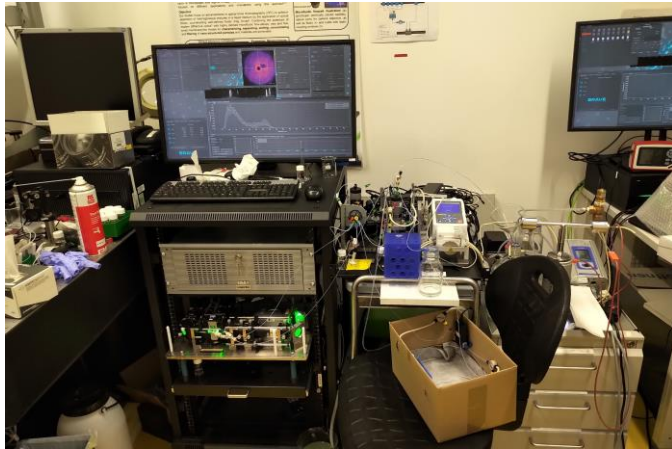
DI Philipp Eibl  
CTO SIMVANTAGE GmbH



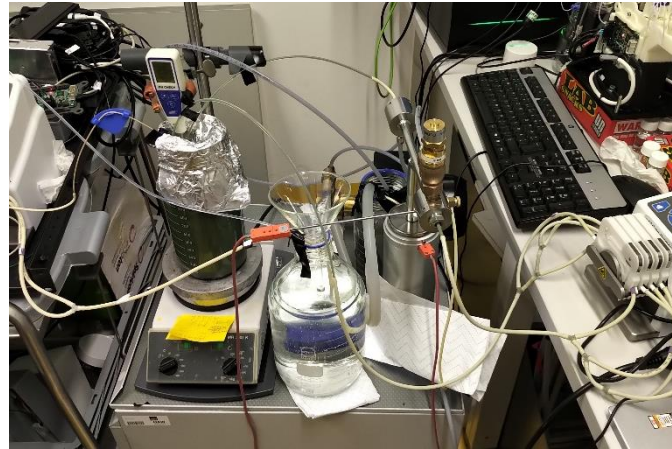
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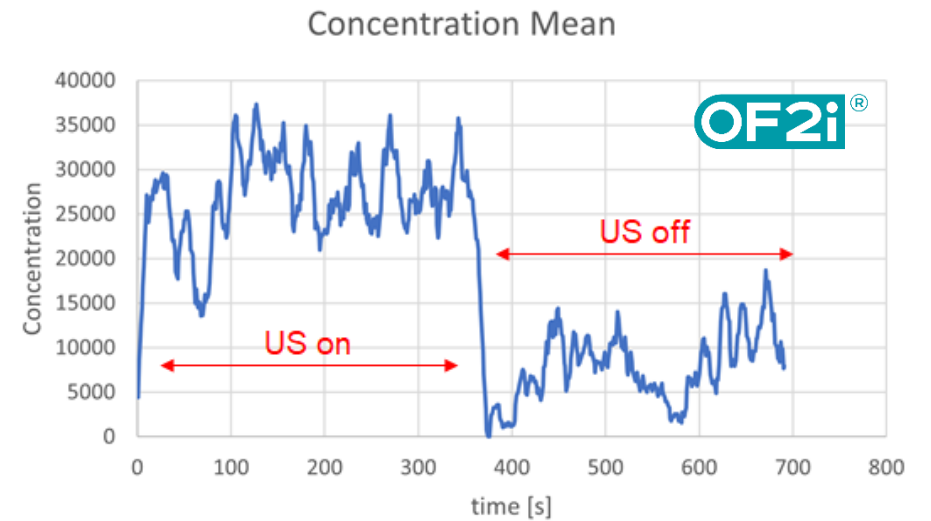
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BRAVE B1 sensor-station (open detector unit), monitoring SiC lab-scale CNANO particles with H.A.N.S. software suite (top); right: continuous dilution system for on-line measurement including continuous ultrasonication..



center: setup electrolyte SiC solution with introduced TUS sensor (right) for on-line monitoring, agitation, temp + pH control, bottom: electrolyte SiC solution with continuous flow ultrasonication setup

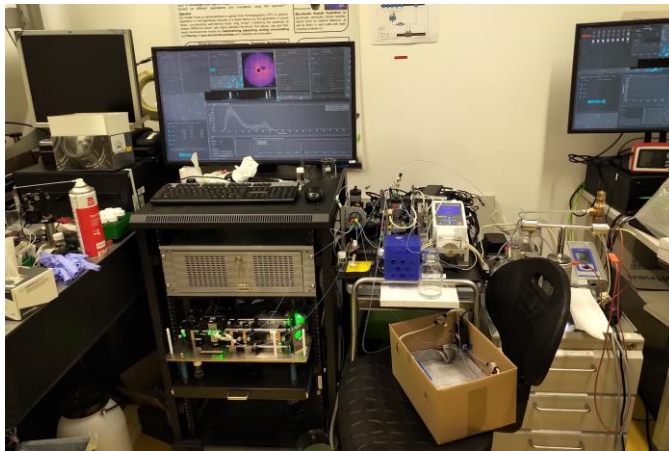


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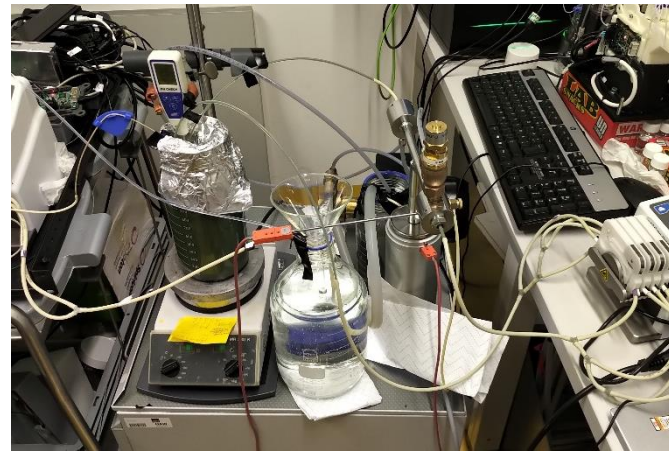
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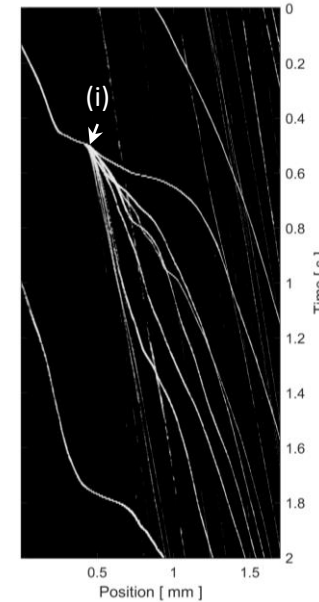
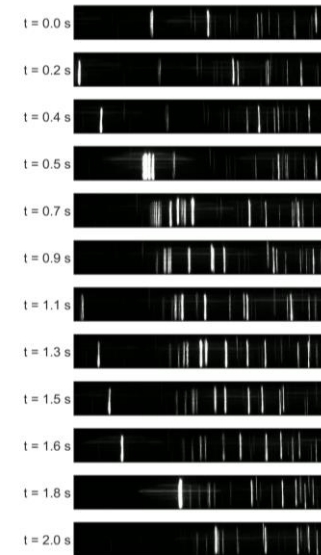
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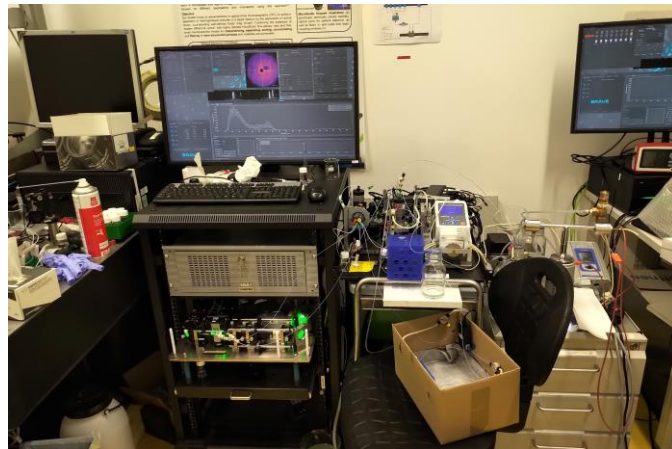
(a) Raw data of a SiC nanoparticles, measured with OF2i at a constant flow rate of 4  $\mu\text{L}/\text{min}$  and an input laser power of 1000 mW. (b) Single particle waterfall diagram created by integration and concatenation of consecutive single frame intensities. At time  $t = 0.5$  s, a single trajectory splits up into several trajectories (i) due to optical forces. This result indicates the presence of particle aggregates.

Preliminary, unpublished data in cooperation with  creative nano

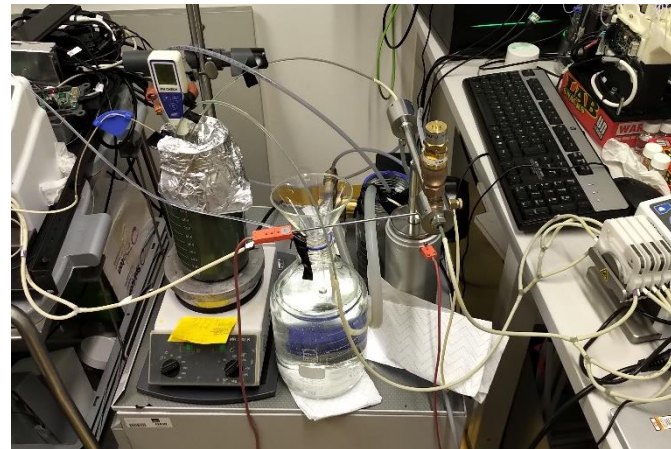
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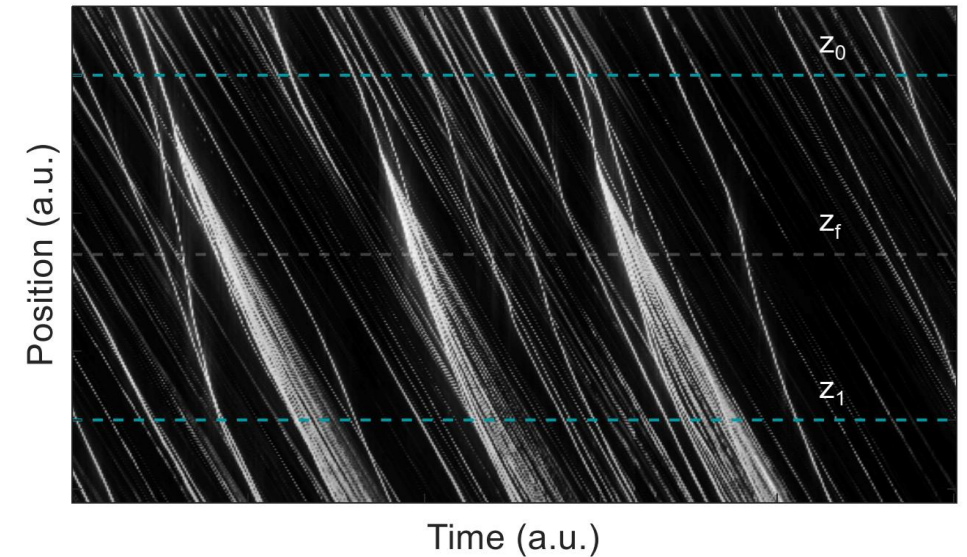
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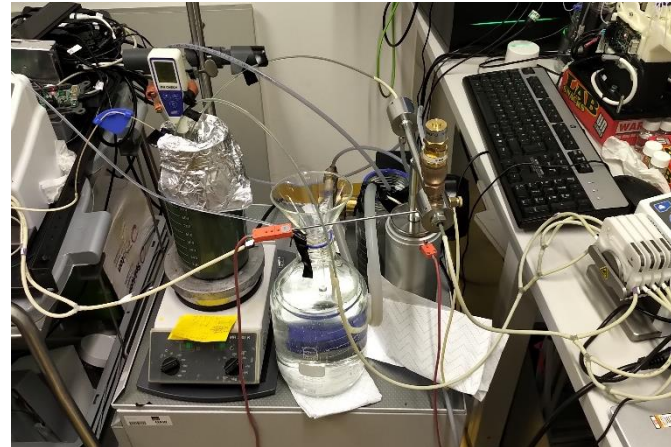
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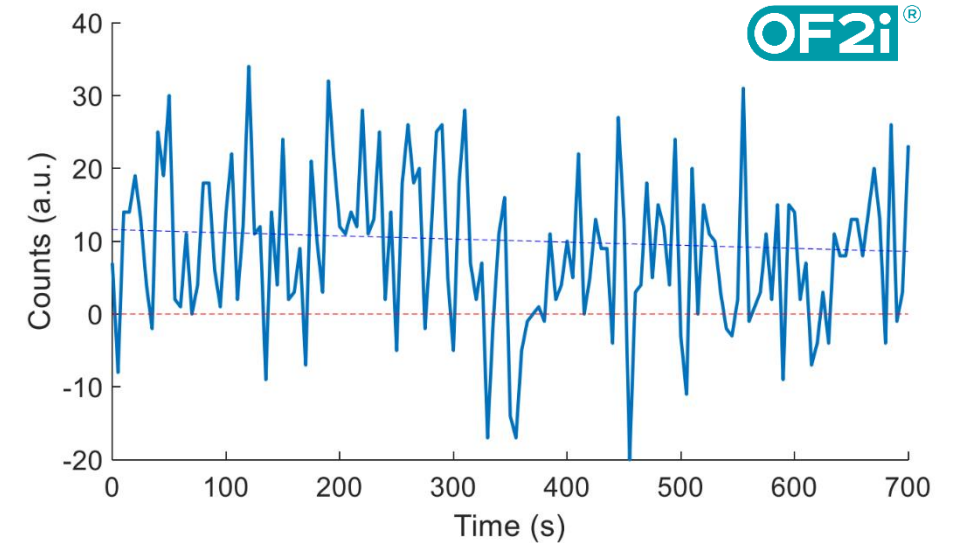
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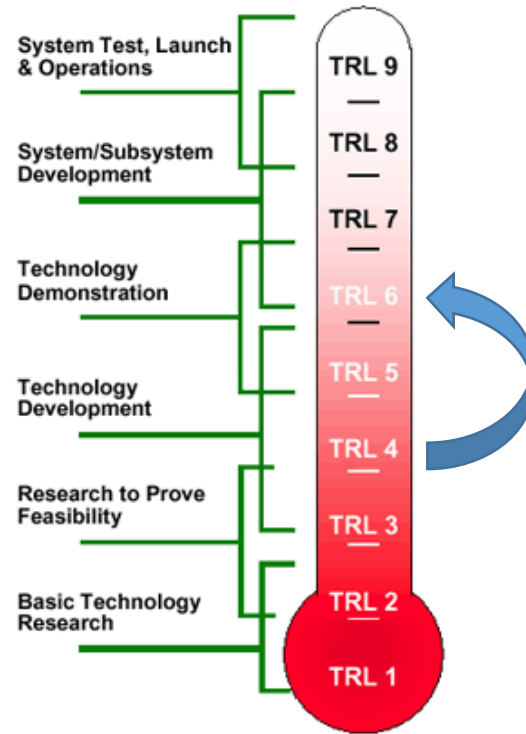
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**ACTIVE PRINCIPLE  
REAL TIME RESULTS**

**CONTINUOUS  
PARTICLE SIZING**

**WIDE SIZING RANGE**

**AUTOMATED &  
INTEGRABLE**

**HIGH SENSITIVITY**



# Role of BNN in NanoPAT



**BNN contact:** Beatriz ALFARO

## Role of BNN:

- Communication & Dissemination manager (webpage, social media, stakeholder engagement, C&D material, newsletters, events, ...)
- Knowledge Transfer and Training activities
- Assessment and implementation of the Safe-by-Design concept
- Contribution to the Exploitation activities

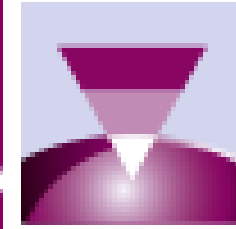
[www.nanopat.eu](http://www.nanopat.eu)



# Contact us

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# THANK YOU, BNN Gold Member Webinar, 31 May 2022



Bundesministerium  
Digitalisierung und  
Wirtschaftsstandort



NanoSyn<sup>5</sup>

FUNDED BY  
Federal Ministry  
Republic of Austria  
Climate Action, Environment,  
Energy, Mobility,  
Innovation and Technology



This project is funded by the Horizon 2020 Framework Programme of the European Union under Grant Agreement Number **862583**

PROJECT PARTNERS

THANK YOU FOR  
YOUR ATTENTION



Zürich University  
of Applied Sciences



ANALYSIS-DSC  
DYNAMIC & SECURITY COMPUTATIONS



ARKEMA



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