MANAGING RISK

NANOTRANSPORT Project

Behaviour of aerosols released to ambient air from nanoparticle manufacturing

-A Pre-normative Study (NMP4-CT-2006-033371)

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Project participants

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Det Norske Veritas	
Dr. Qinglan Wu	Knowledge gap identification
Dr. Jan Weitzenböck	Project management
University of Karlsruhe	
Prof. Gerhard Kasper	Experimental work and results analysis
Dr. Martin Seipenbusch	Recommendations
Dipl.-Ing. Axel Binder	
Grimm Aerosol Technik GmbH & Co. KG	
Dr. Hans Grimm	Monitoring equipment and measurement techniques
Dr. Jürgen Spielvogel	

Goals of NANOTRANSPORT

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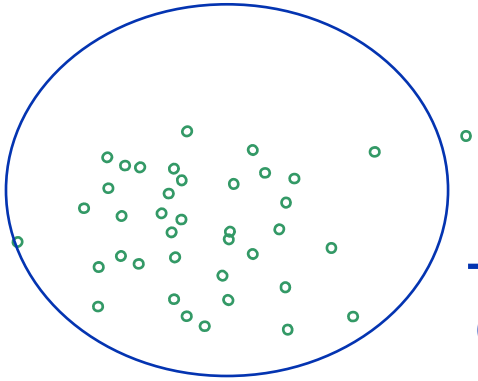
Occupational health risks of nanoparticle exposure through inhalation

- **Study agglomeration dynamic** of nanoparticle aerosols after release into simulate workplace environment for specific exposure scenarios
- **Develop recommendations for EC** regarding
  - Test aerosols for nanotoxicology studies
  - Testing of filters and protective equipment in the workplace
  - Research priorities

Experimental program

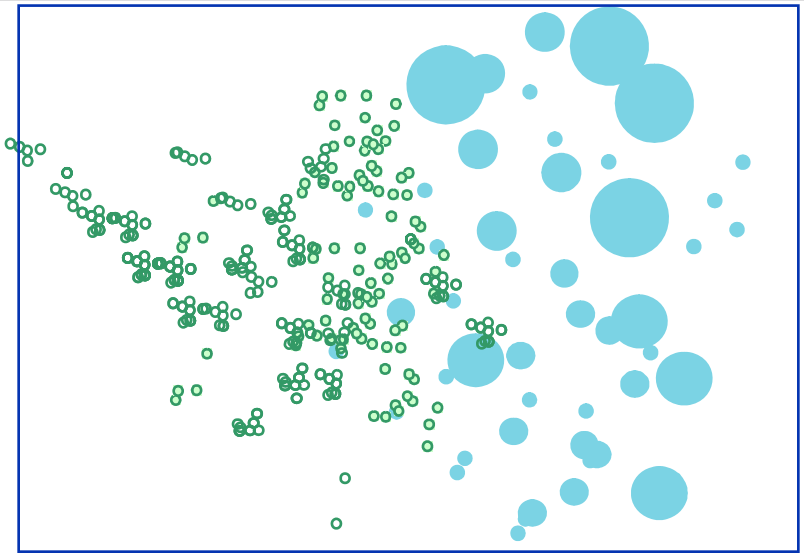


Release of primary nanoparticles (NP)

Agglomeration

Continuous release

Discontinuous release



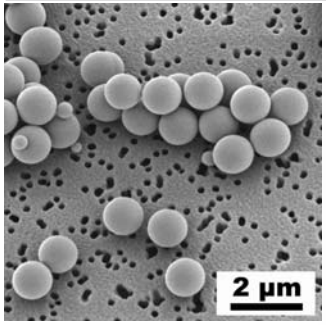
Interactions with background aerosol (BA)

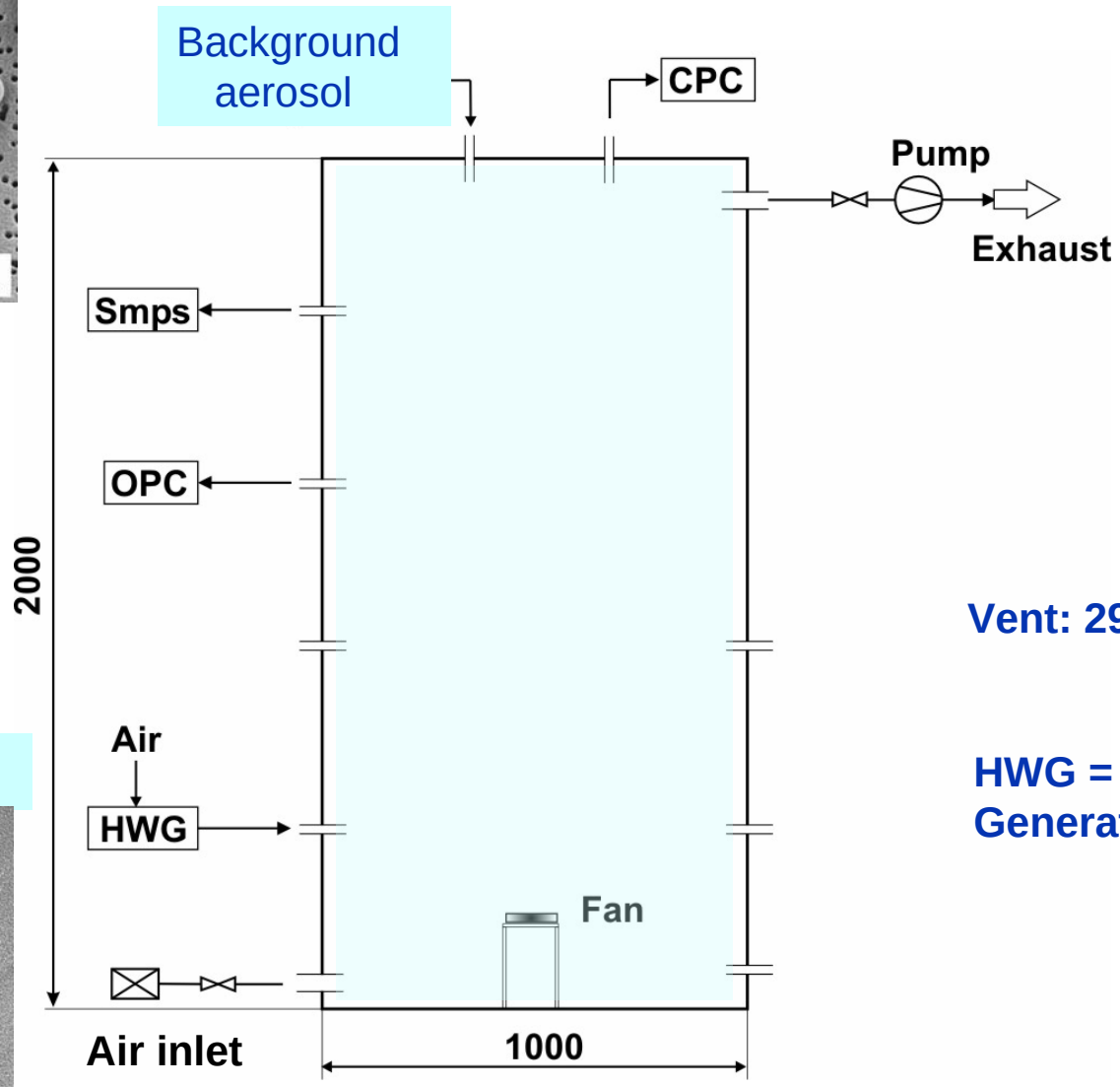
$C_{NP} >> C_{BA}$

$C_{NP} \approx C_{BA}$

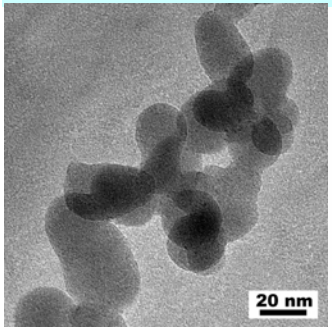
$C_{NP} << C_{BA}$

Experimental Set-up





NP generator



Vent: 2900 min^{-1} = 170 m^3/h

HWG = Hot Wire Generator, 5 lpm Air
I=4 A, U=4.5 V

By Martin Seipenbusch, University of Karlsruhe

Continous release of NP aerosol into a clean room: homogeneous coagulation

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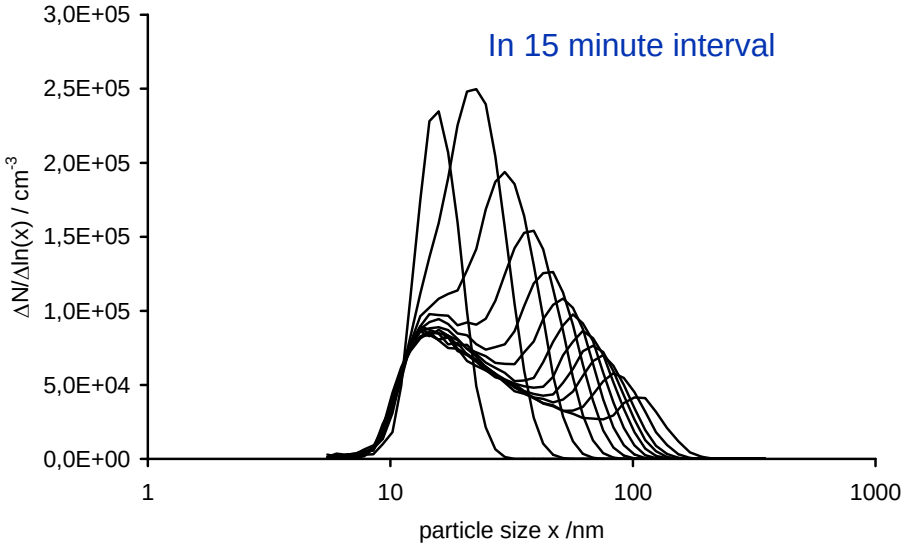
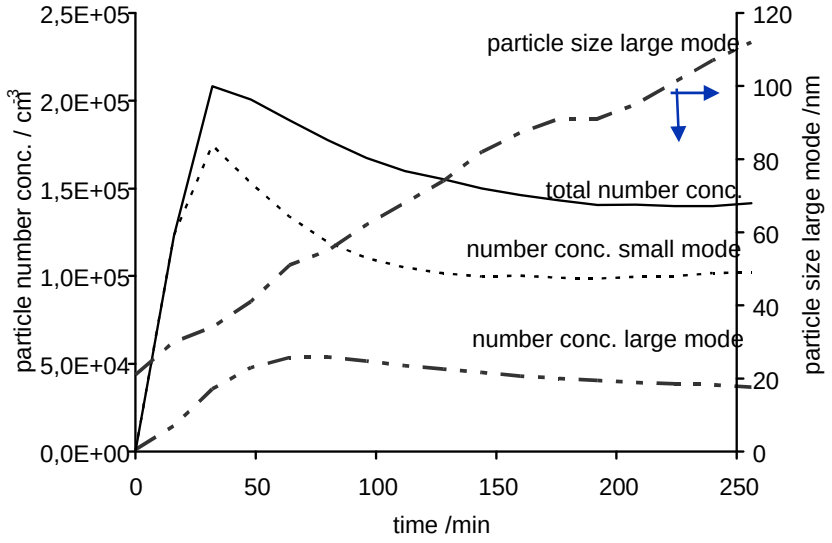
By M. Seipenbusch et al., University of Karlsruhe

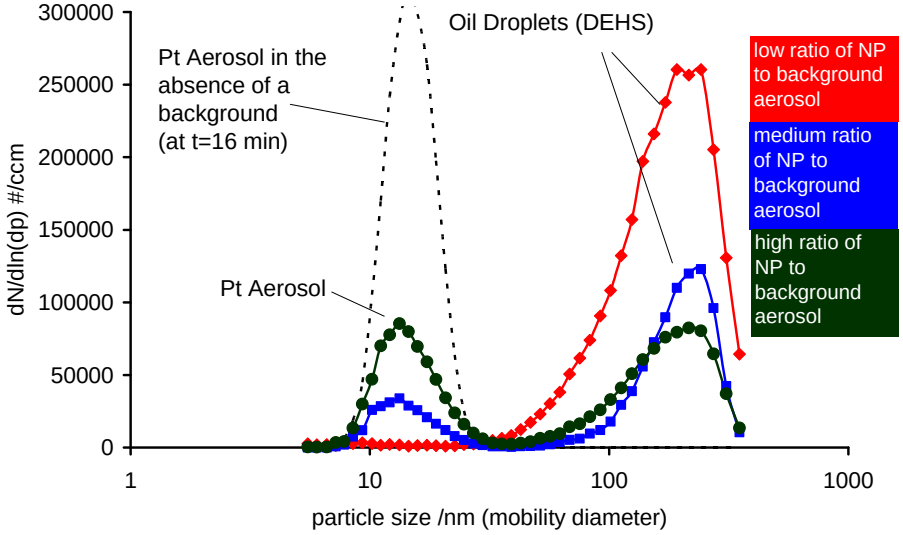


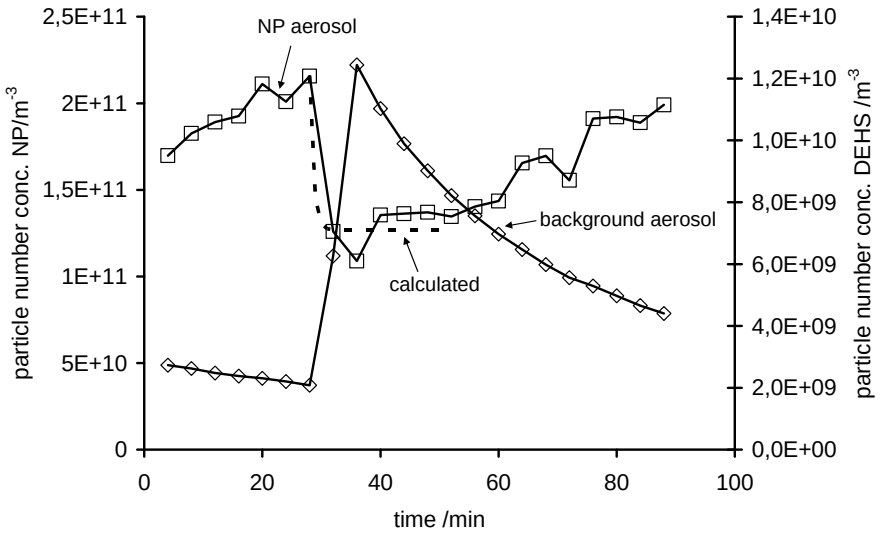


- Nanoaerosols evolve considerably with time:
  their average size increases while concentration decreases
- A relative stable particle size distribution with two characteristic peaks in the range of 20 -100 nm appear after certain initial time

Continous NP aerosol source in a simulated ambient background: scavenging/ heterogeneous coagulation

By M. Seipenbusch et al., University of Karlsruhe





- Natural background aerosols are scavengers for NP
- The agglomeration kinetic can be well described by using a aerosol dynamic model developed

Prediction of Pt NP number concentrations in present of background aerosols

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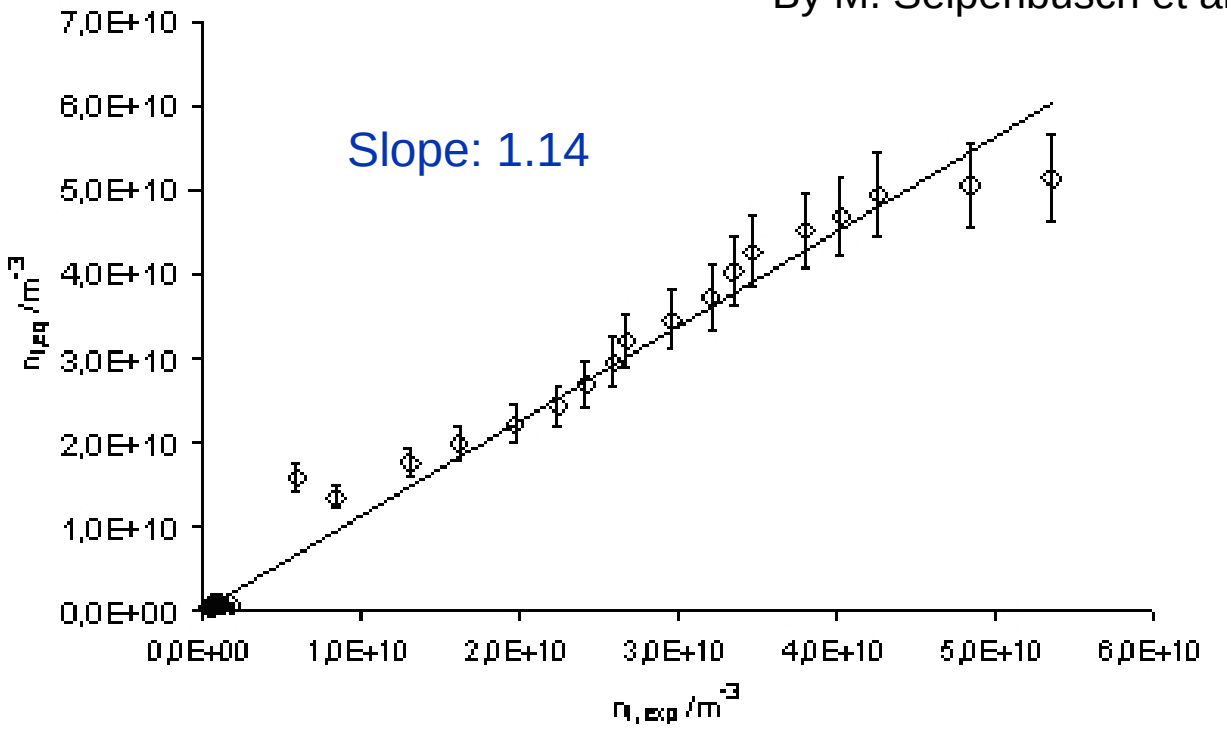

- Good correlation between equilibrium concentrations calculated and experimental values
- Key parameters controlling the NP concentration with time are: the NP source rate and primary size, air flow velocity, concentration and size of background particles

Key conclusions from the study

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- Nanoaerosols evolve considerably with time
- Natural background aerosols are scavengers for NP
- The time scale for size evolution depends on concentration of NP and that of background aerosol- on the order of a few minutes to 30 min.
- NP will be present in size classes other than the one in which they were originally emitted.
- Filtration efficiency for primary NP not an issue, but agglomerates may be in the Most Penetrating Particle Size range between 100-300 nm (MPPS).

Recommendations to EC under discussion

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- Test aerosols for nanotoxicology studies
  - Aged NP aerosols (including agglomerates) and primary NP equally relevant for risk assessment in workplace environment
  - Generate test NP via aerosol phase (including aging and scavenging) to simulate the scenario of primary NP release in workplace air
- Testing of filters and protective equipment in the workplace
  - Consider the filter efficiency for the size range of agglomerates in addition to primary NP, with the focus on MPPS
- Research priorities
  - Validate and refine (existing) aerosol dynamic models for predicting NP evolution in workplace for specific scenarios
  - …

(more information can be found on NANOTRANSPORT website:----)

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Thank you!