

# Måling af nanomaterialer i luften . hvilke udfordringer er der?

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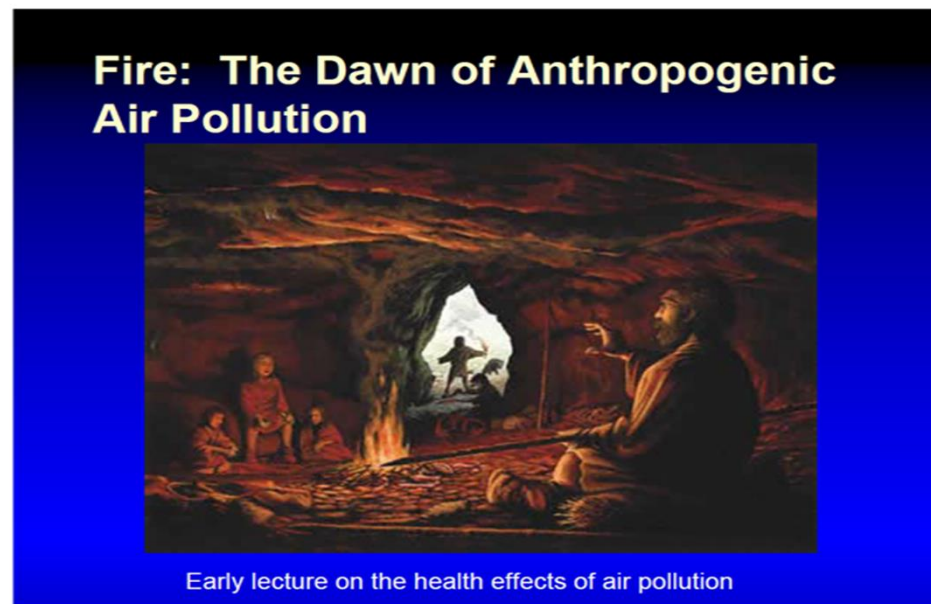
# Content

- “ Issues with the ENM measurements
- “ Examples of current advanced online measurement devices to assess number, surface area, size-distributions online, and their working principles. (Acbach et. al. 2012)
- “ The complications in obtaining the truth using these instruments.
- “ Efforts done to improve present situation



# Problems

- “ Modern aerosol science is relatively young
- “ Aerosol research has been motivated by air pollution related health problems.
- “ Small particles were considered unimportant
- “ Regulations were/are based on mass measurements
- “ Technical issues



# Materials

- “ Aerosol instruments are designed primary for the ideal spherical particles and atmospheric aerosols.
- “ ENP $\phi$ s are rarely spherical and their sizes and concentrations are usually very different from the atmospheric aerosol properties.
- “ Instruments are difficult to calibrate, because of the large variety of materials.

# Microscopicity- Í the truthî

- ” Volatility (beam damage, sampling, storage)
- ” Sampling
- ” Time consuming
- ” Poor statistic
- ” Selective technique  
(user is making a decision  
what you will see)
- ” Expensive



# Tiered approach

- “Tier 1 : Exposure assessment based on production site and materials, (total number concentration measurements)
- “**Tier 2** : Simple measurements; number concentration, surface area or/and sample for microscope analysis.
- “Tier 3 : Complete exposure analysis



# Instrument performance

- “ Paper by Asbach et. al., **Comparability of Portable Nanoparticle Exposure Monitors**, *Ann. Occup. Hyg*, No. 5 pp.606-621, 2012.
- “ Five different instruments/monitors which are designed to detect ENM.
- “ CPC 3007, miniDisc, nanoTracer, nanoCheck and Aerotrak 9000



# General working principle of on-line ENM instrument

- “ Usually consist three(four) parts: pre-impactor, charging unit, detection unit.
- “ Sample aerosol is charged
- “ (Possible size classification)
- “ Instruments are measuring current
- “ After assumptions, data analysis gives you the %measured+ unit. (number, surface area, mass etc.)
- “ ***More complicated unit you want to measure, more you need assumptions.***





# Test aerosols

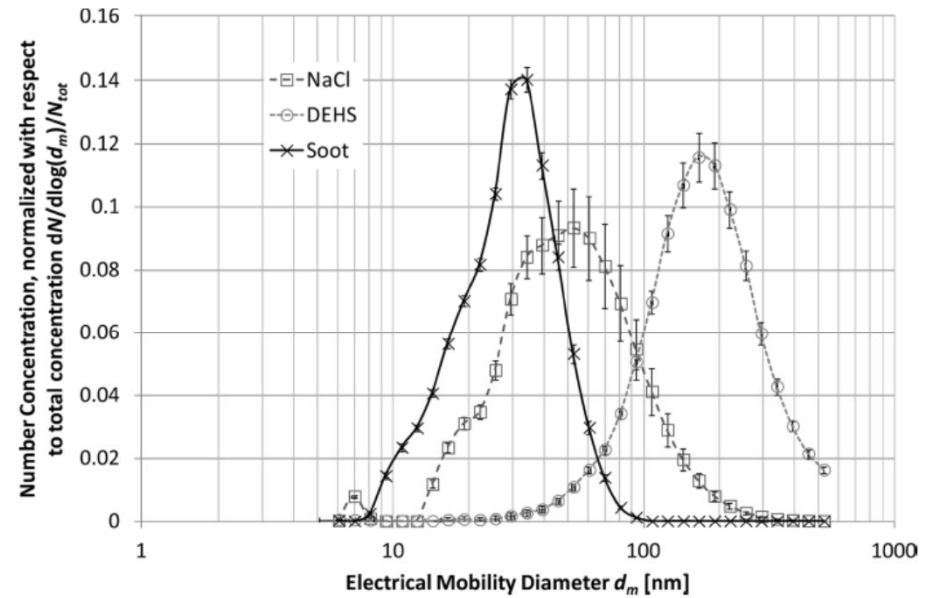


Fig. 1. Particle number size distributions of the NaCl, DEHS, and soot test aerosols, normalized with respect to the total number concentration; measured with an FMPS.

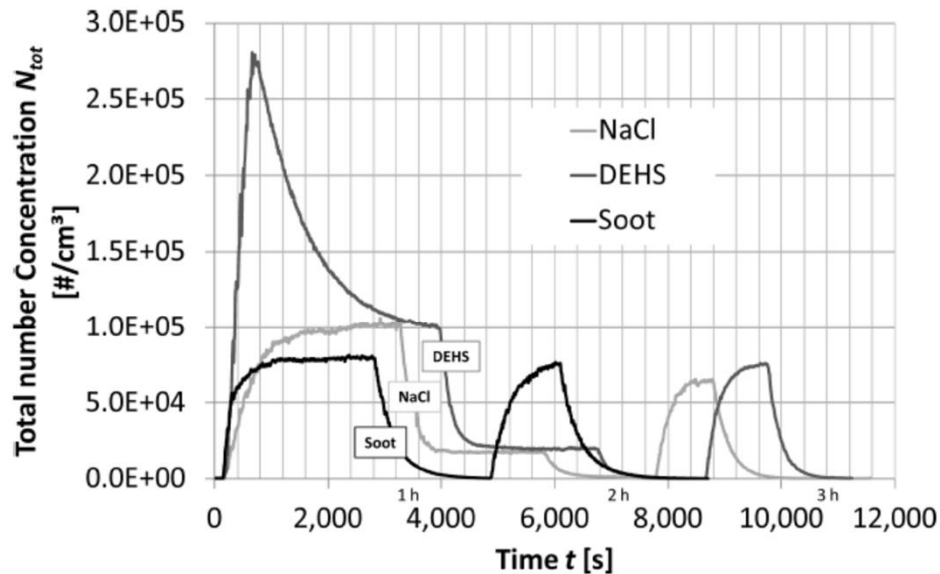


Fig. 2. Total number concentration profiles during the test for NaCl, DEHS, and soot particles, measured with FMPS.



Asbach et. al 2012

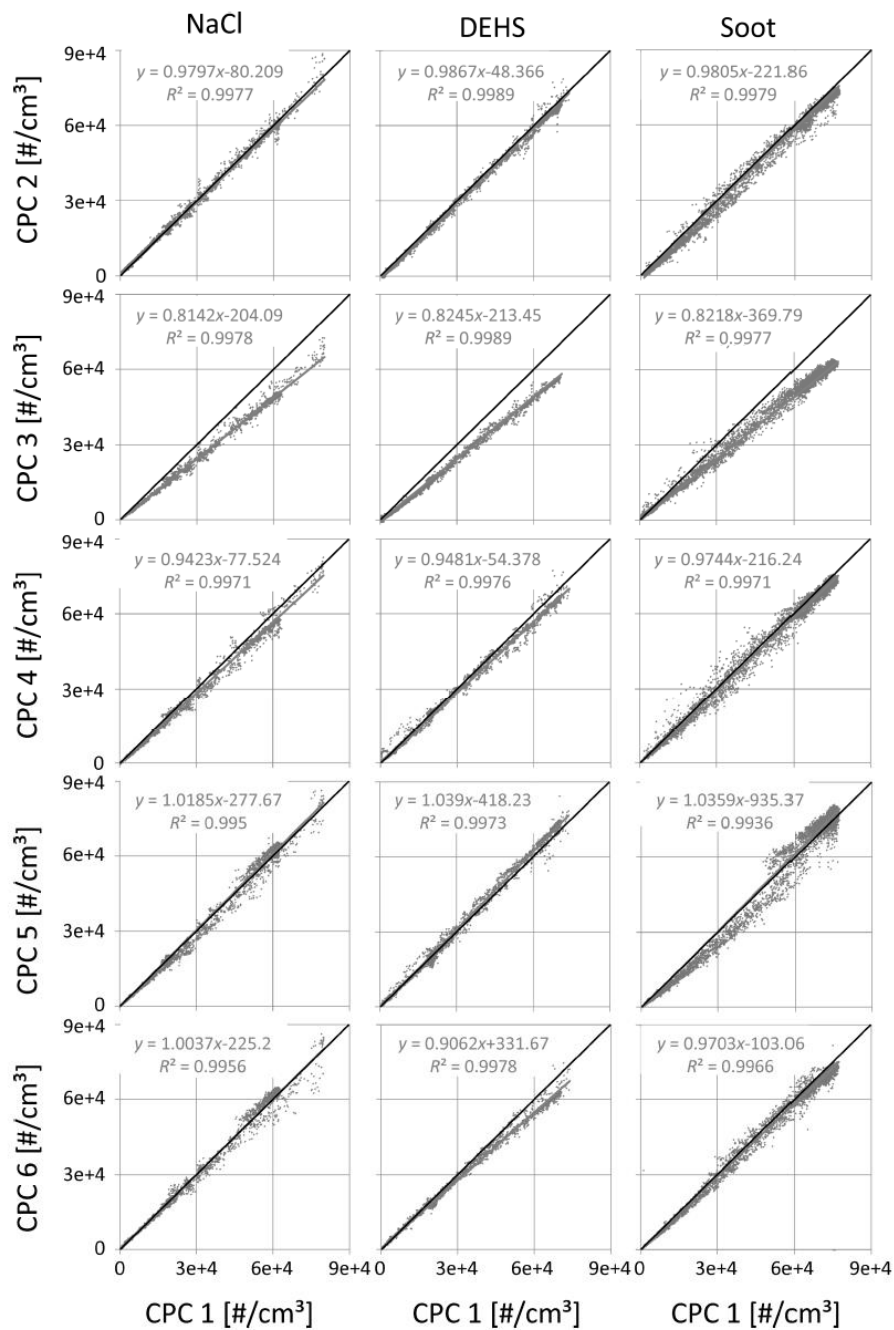


Fig. 3. Regression analyses for the total number concentration measured with CPC 2–CPC 6 compared with CPC 1, tested with NaCl (left), DEHS (center), and soot (right) particles; all data are 1-s measurement values.





miniDiSC 2 [# /cm<sup>3</sup>]

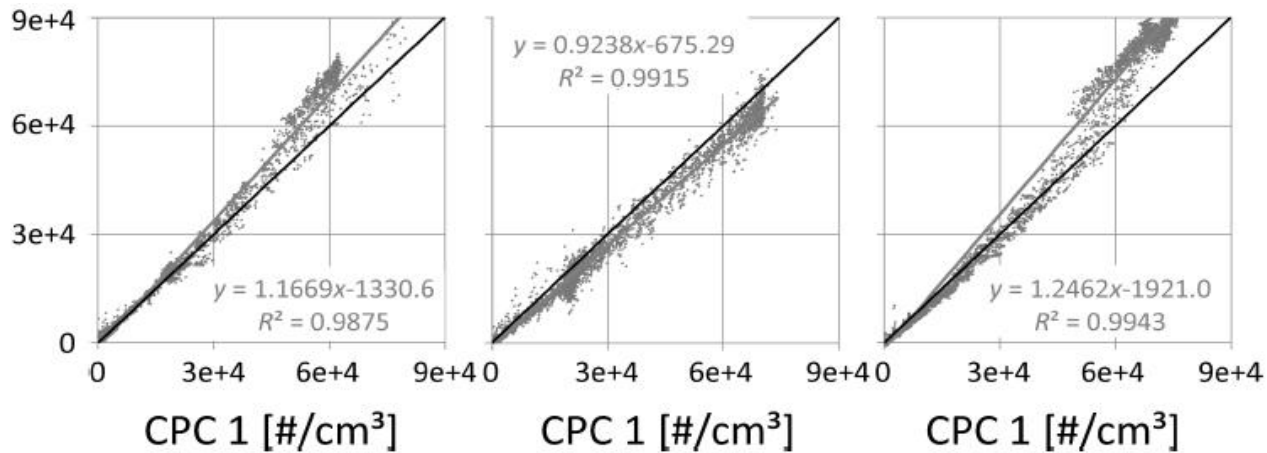


Fig. 4. Regression analyses for the total number concentration measured with miniDiSC 1 and miniDiSC 2 compared with CPC 1, tested with NaCl (left), DEHS (center), and soot (right) particles; all data are 1-s measurement values.



nanoTracer2 [# /cm<sup>3</sup>]  
nanoTracer3 [# /cm<sup>3</sup>]

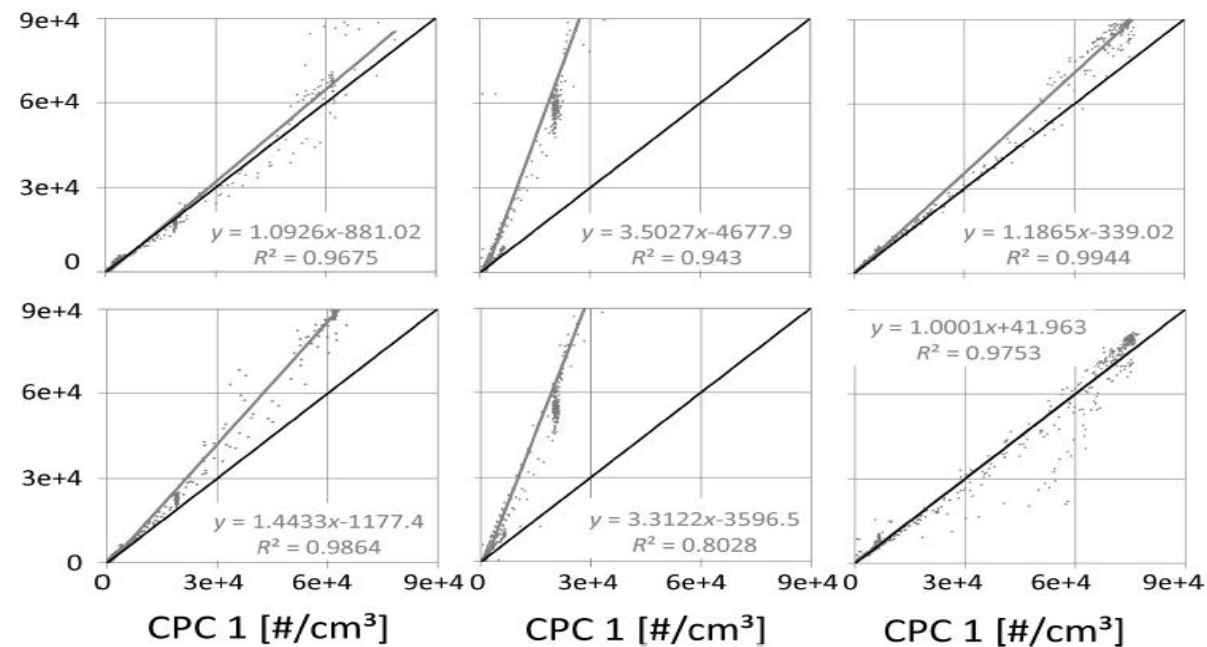


Fig. 5. Regression analyses for the total number concentration measured with nanoTracers 1–3 compared with CPC 1, tested with NaCl (left), DEHS (center), and soot (right) particles; all data are 16-s measurement values, nanoTracer as reported by the device, CPC data averaged over the same 16 s for each data point; note that the average size of the DEHS size distribution was out of the specified range for mean particle sizes; nanoTracer 3 was mounted on a wall during NaCl measurements, which influenced the sample aerosol.

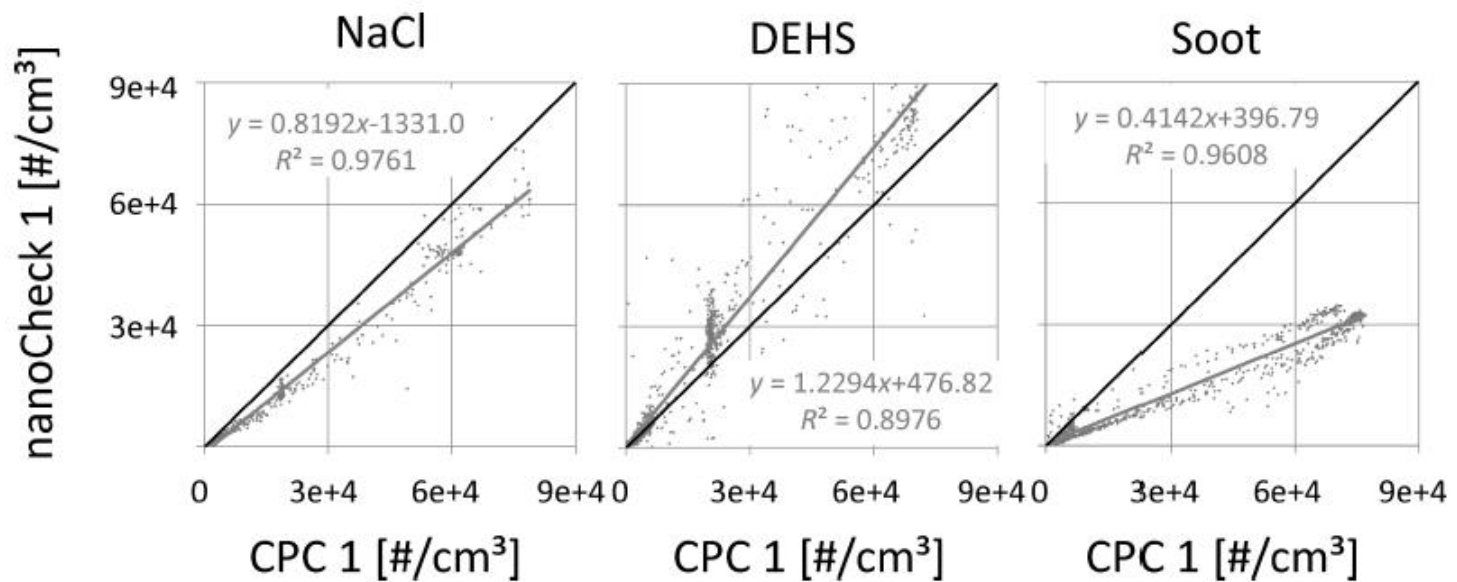


Fig. 6. Regression analyses for the total number concentration measured with nanoCheck 1 and 2 compared with CPC 1, tested with NaCl (left), DEHS (center), and soot (right) particles; all data are 10-s measurement values, nanoCheck as reported by the device, CPC data averaged over the same 10 s for each data point.

# Surface area

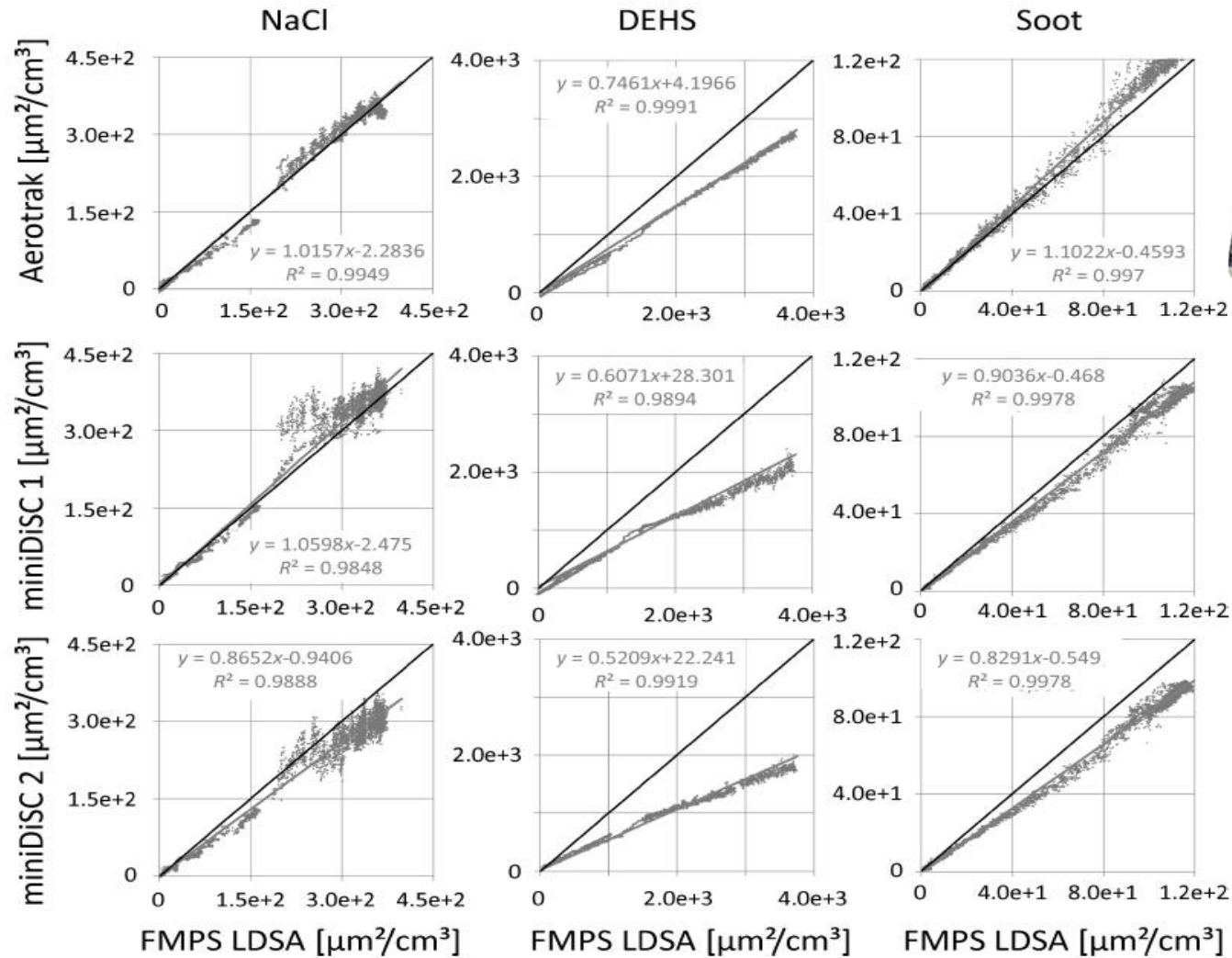


Fig. 7. Regression analyses for the alveolar LDSA concentration measured with Aerotrak 9000 (top), miniDiSC 1 (center), and miniDiSC 2 (bottom) compared with alveolar LDSA concentrations, calculated from FMPS measurements; all data are 1-s measurement values.

# Efforts to solve these problems

- “ Danish Nano Safety Centre, WP1.1
  - “ Detailed focus on instruments performance with different materials.
- “ NANODEVICE
  - “ Developing new instruments to measure and detect ENM.



# Conclusions

- “ Current state of the art online monitors is not yet fully suitable for regulatory application (if threshold limits for number, surface area, or size-distributions are enforced)
- “ NanoDevice Nano Safety Centre.
- “ Measurements in Different industrial branches would help to assess different sources.
- “ In the current state of the instruments measurements should be conducted by professionals.

