

Characterization of spray aerosols generated from particle-free solutions and nano-particle containing suspensions (NANOaers)

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Motivation

Engineered nano materials (ENM) have a wide range of uses as additives in sprays (e.g. cosmetics, cleaning products, and coatings). The application of sprays generates an overspray, which may be inhaled by the user. The health risks of the inhaled aerosol depend on the particle size, but also on the composition of the aerosol. Small particles, including those in the nanometer size range, can reach deeper regions of the respiratory system. In turn, the aerosol particle size distribution depends on the parameters of the spraying process and the properties of the atomized fluid. Therefore, we wanted to investigate, what influence has gradually adding of the components from our desired solution on the size distribution in the dried aerosol. At the final step, CeO₂ was added as the selected ENM.

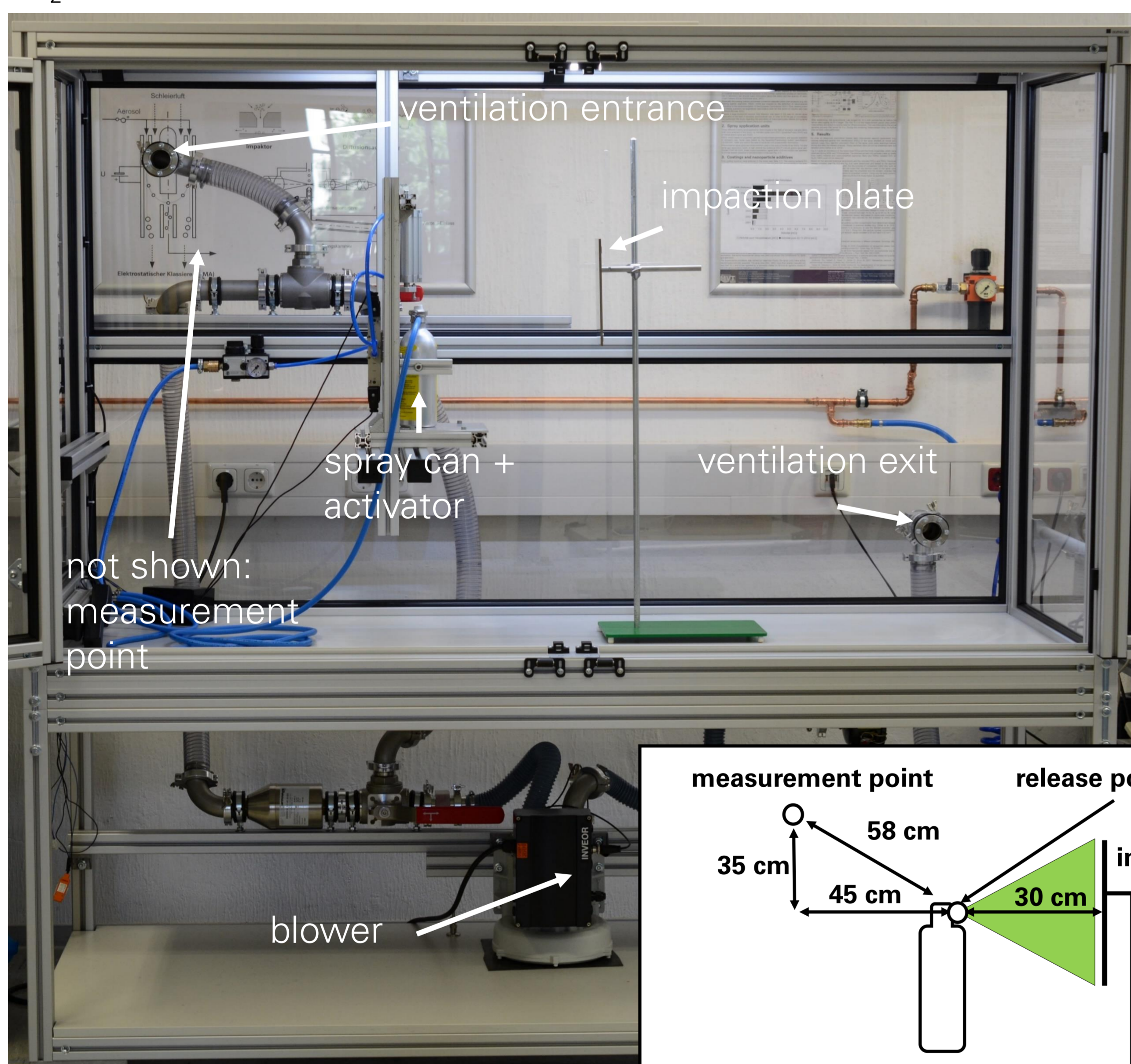


Fig. 1: Exposition chamber

Experimental

An exposition chamber (fig. 1) with ventilation system and a spray can for customized application was developed and used for the experiments. The chamber was ventilated with particle free air until a background concentration below 10 cm⁻³ was reached. Then the ventilation system was switched off and the spray can was activated for 5 s with a pressure of 6 bar. The particle size distribution was measured 3.5 min after spraying in a defined distance behind the can (see sketch in fig. 1).

See also poster nr. xx: similar experiments were carried out by spraying onto textiles.

Abbreviations and concentrations

- EthOH = Ethanol (57%)*
 - MEK = Methyl ethyl ketone (0.8%)*
 - TEA = Triethanolamine (0.4%)*
 - HCl (0.6%)*
 - Silanes (3%)*
 - H₂O (depends on mixture)*
 - NM213 = CeO₂ < 200 nm (0.0035)*
- *calculated by mass

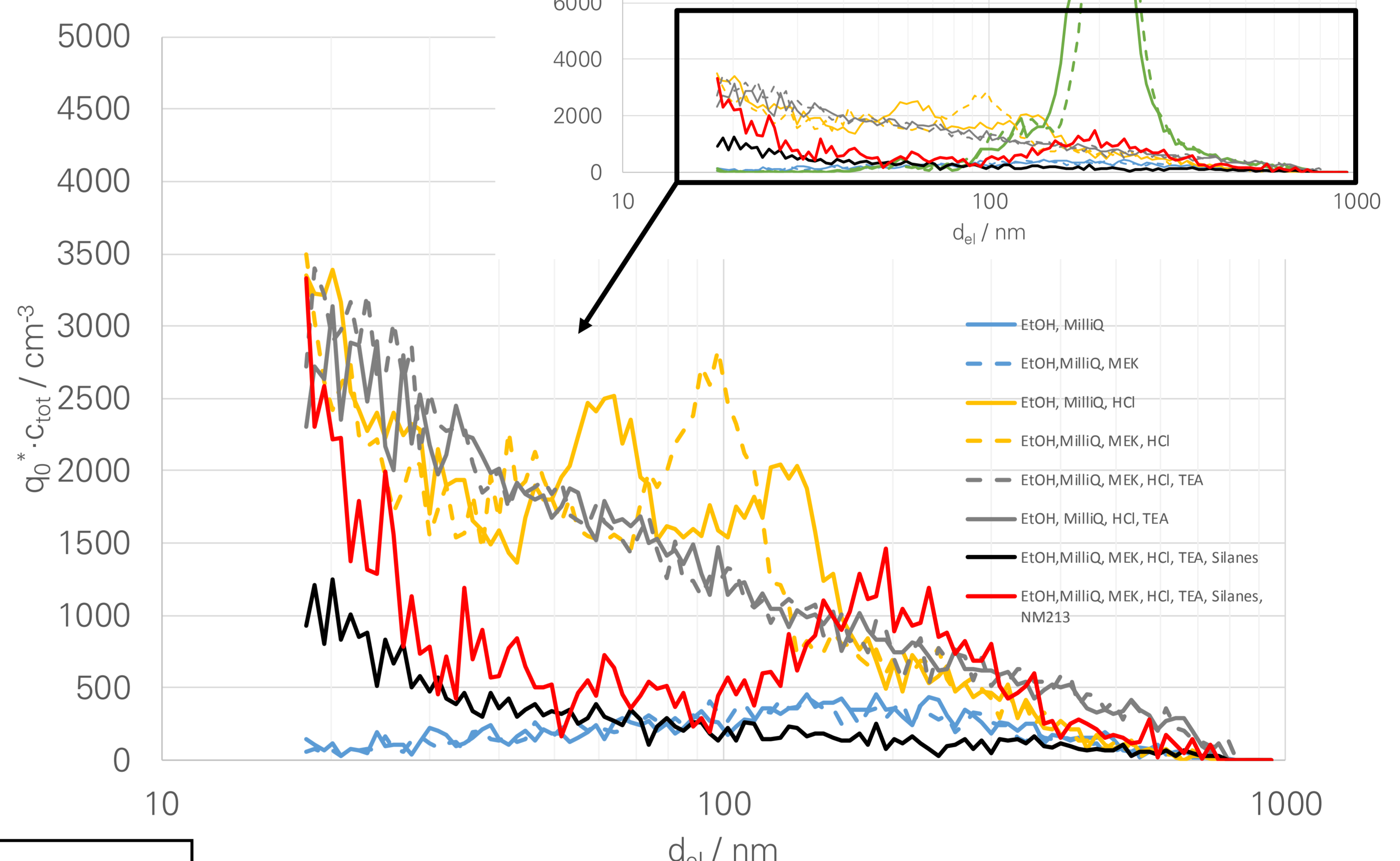


Fig. 2: Size distributions of dried particle

Conclusion

- In the following the size distributions of fig. 2 are discussed by color of the curves:
- blue: MEK has no influence on size distribution compared to H₂O/EthOH
 - green: adding TEA leads to much higher particle concentration and peaks between 100 and 300 nm
 - yellow: HCl increases number concentration and leads to peaks around 100 nm
 - grey: HCl and TEA together show no peaks in the measurement range
 - black: adding Silanes leads to a decrease in the number concentration (representing the desired solution without ENM)
 - red: finally adding NM213 leads to peaks around 200 nm

The measured size spectra of dried aerosols show, that the fluid components have a large influence. Even adding a low amount of single chemicals can lead to a significant change of the size distribution. Therefore it is not advisable to exclude an component without further ado.

Outlook

More experiments with CeO₂- and Ag-ENM containing particles are planned. For cell exposure also a spray channel setup was built and first results indicate a deposition of ENM on cells from the overspray.