# Investigation of the likelihood of nanomaterial agglomerates to break apart into smaller agglomerates or primary particles – developing an integrated tool to identify nanomaterial release into the environment

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The stability of nanomaterial agglomerates is an important parameter for toxicological studies and for estimating the particle size of airborne nanomaterials. The aim of this study is to develop a system that effectively tests the potential of different type of nanomaterials to deagglomerate within a wide range of applied energies.

The aerosolization is achieved by fluidic agitation of nanopowders (figure 1). Humidity controlled air can be introduced to allow studying the humidity dependence of aerosol stability. The pressure change is carefully controlled to ensure a range of shear forces can be applied onto the particles in a critical orifice. The aerosol is measured in a stabilization chamber by the Scanning Mobility Particle Sizer (SMPS) for the size distribution and is collected on the TEM grids for morphology analysis.

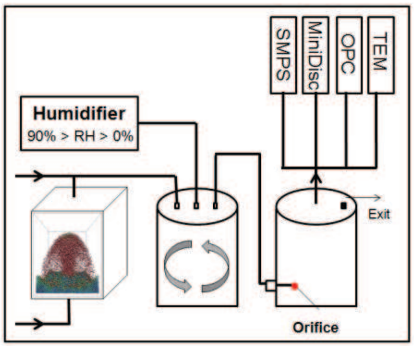


Figure 1. Schematic presentation of aerosolization and de-agglomeration system

Stable generations of silica aerosol were successfully obtained as shown in figure 2. The particle number and size distribution showed associations with the air flow supplied.

The de-agglomeration tests generated unexpected results, as the particle mean size increases under intermediate pressure difference. When the pressure gap is further elevated to 2.5 bars, the particle size goes down again (figure 3). One of the possible explanations to this effect is that due to the restriction of the orifice the chances of particles colliding with each other increases which leads to bigger agglomerates, while the shear force applied in this case is not sufficiently strong to break up these agglomerates. However, When the shear force is further enhanced, part of the loose agglomerates start to be defragmented.

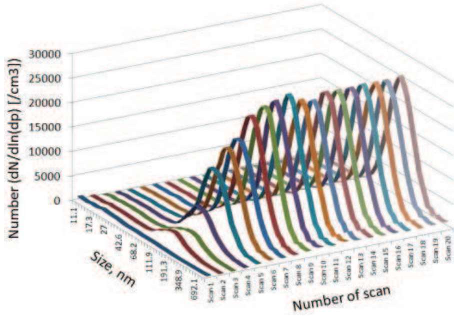


Figure 2. Evolution of particle number concentrations and size distributions over time (continuous SMPS scans, period about 70 minutes).

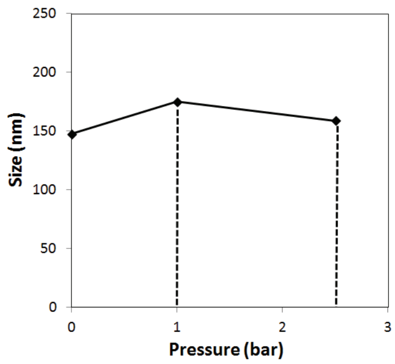


Figure 3. Particle mean size measured under different pressure conditions (SMPS)

The preliminary results suggest that we are able to generate stable aerosols for later treatments under different conditions. The particle size distribution are influenced by pressure difference across the orifice. Next, various humidity conditions (30%-70%) will be applied which allows insights of aerosol stability related to this factor. In addition, different nanopowders will be tested to assess the robustness of the system.

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