Short wavelength optical characterization of aerosol nanoparticles in a flow tube

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Keywords: nanoparticle formation, short wavelength, SAXS, flow tube.

Gas-to-particle conversion is known to dominate the aerosol number concentration in the global atmosphere (Kulmala *et al.*, 2004). The rigorous study of airborne particles in the size range from 1 nm to 50 nm is hence crucial for a better understanding of the underlying nanoparticle formation mechanisms. Conventional techniques are able to retrieve size information from electrical mobility analysis or use mass spectrometers to determine the chemical composition of nanoparticles. However, most techniques suffer from insufficient time resolution (Winkler *et al*., 2012).

Noninvasive optical approaches provide size and structure information at time scales as low as milliseconds. To this end, wavelengths close to the size of the particles are needed. For the study of nanoparticles this implies radiation at wavelengths close to or below 1nm. Accordingly, x-rays (ca. 0.2 – 1 nm) can be considered appropriate for optical nanoparticle characterization.

Small Angle X-ray Scattering (SAXS) is commonly used in material science or in biochemical process analysis in order to acquire structural information from 1 nm to 50 nm. In aerosol science this approach promises in situ information on nucleation mode particles (Laksmono *et al.*, 2011). Here we report experiments conducted recently at the SAXS beamline at the Elettra synchrotron Triest. We have chosen this beamline due to high beam intensity and the available experience on aerosol studies in flow tubes (Jungnikl et al., 2011). We extended this approach to the study of newly formed biogenic particles from the ozonolysis of α-pinene. To provide a representative environment for aerosols a flow tube with a movable inlet for variable residence time was used. Figure 1 displays a sketch of the flow tube setup at the synchrotron. A Differential Mobility Particle Sizer (DMPS) and a Condensation Particle Counter (CPC) were run in parallel to allow direct comparison of the SAXS data to the conventional aerosol measurements. Figure 2 presents SAXS intensities of biogenic nanoparticles measured at different inlet positions, reflecting the particle evolution at different residence times.

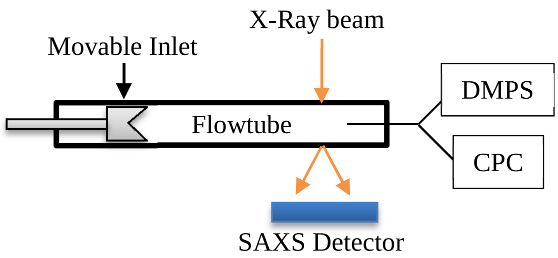

Figure 1. Sketch of the flow tube setup at the SAXS beamline at Elettra.

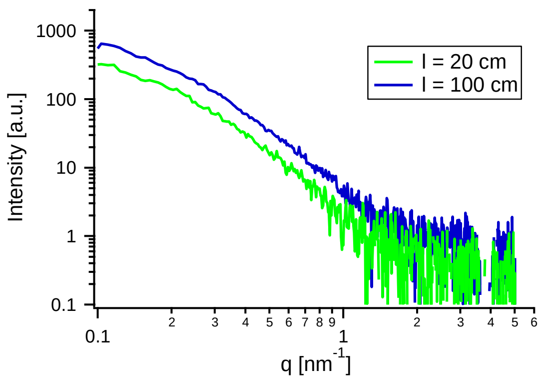

Figure 2. Scattering intensity of SAXS measurements at different inlet positions in the flow tube.

This work was supported by the European Research Council under the European Community's Seventh Framework Programme (FP7/2007-2013) / ERC grant agreement No. 616075.

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