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In-situ nanoparticle characterization at ambient pressure and concentrations by Small Angle X-ray Scattering

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Abstract:

State-of-the-art aerosol nanoparticle techniques have all one in common: for analysis they remove the nanoparticles from their original environment. Thereby physical and chemical properties of the particles might be changed or cannot be measured correctly. To overcome these shortcomings, synchrotron based small angle x-ray scattering (SAXS) is applied as in-situ measurement technique in this thesis. Contrasting other SAXS aerosol studies, comparatively low particle concentrations are used which allows parallel measurements with conventional aerosol analyzers. To this end, aerosol nanoparticles are analyzed at ambient pressure and concentrations of about $\sim 10^6 \text{ cm}^{-3}$. A differential mobility particle sizer (DMPS) and condensation particle counter (CPC) are operated in parallel. By this comprehensive combination of the various techniques measurements of concentration, size and morphology of the aggregates and primary particles are possible. To conclude, in-situ nanoparticle characterization with ultra-low volume fractions of $\sim 10^{-10}$ is feasible with SAXS providing important information on the morphology of the nanoparticles.