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Influence of Sulfur Dioxide on Nucleation, Growth Rates and Yield of Secondary Organic Aerosol

A. Metzger (1), B. Verheggen (2), J. Duplissy (1), K. Gaeggeler (1), J. Dommen (1), A.S.H. Prevot (1), U. Baltensperger (1)

(1) Laboratory of Atmospheric Chemistry, Paul Scherrer Institut, Villigen, Switzerland, (2) Department of Air Quality and Climate Change, Energy research Centre of the Netherlands (ECN), Petten, Netherlands

A laboratory study was carried out to investigate the secondary organic aerosol (SOA) formation of 1,3,5-trimethylbenzene (TMB) in the presence of SO_2. Several experiments were carried out using SO_2 concentrations between 0.2 and 20 ppb and TMB concentrations from 150 to 1200 ppb, while keeping all the other parameters constant. The empirical particle nucleation and growth rates were determined from the aerosol size distribution, using the recently developed inverse modeling procedure PARGAN (Particle Growth and Nucleation).

The role of sulfuric acid (SA) in particle formation was studied by determining the power law dependencies between SA and particle concentrations or particle formations rates. The measured aerosol nucleation rates were proportional to the SA concentration with the first to second power. This is similar to ambient observations (1), while other laboratory binary homogeneous nucleation studies found dependences of the nucleation rate on SA concentration to the power of five to eight (2).The threshold of the SA concentration when 3-nm particles start to appear was determined to be $2.5\text{x}10^{6} \pm 0.5\text{x}10^{6}$molecule cm^{-3}, which is close to ambient observations.

The observed nucleation and growth rates will be discussed with regard to SO_2/ SA as well as TMB concentrations. The effect of SO_2 on the SOA yield and SOA composition will be discussed.

(1) Ball, S.M., et al., JGR, 1999. (2) Riipinen, I., et al., ACP, 2007.