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Secondary Organic Aerosol Formation from Glyoxal: photochemical versus dark uptake and reversible versus irreversible SOA formation

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Glyoxal forms secondary organic aerosol (SOA) by partitioning to the aerosol aqueous phase according to Henry's law. The subsequent processing by heterogeneous and multiphase reactions shifts the partitioning towards aerosols. Currently it is not well understood whether these reactions result in reversible or irreversible SOA formation, and what parameters influence the rate limiting step of multiphase processing. We conducted a series of simulation chamber experiments at PSI in April and May 2011 to investigate processing under dark conditions, UV and/or visible light irradiated conditions, and in the presence and absence of OH radicals. Experiments used ammonium sulfate or ammonium sulfate/fulvic acid mixtures as seed aerosols, and were conducted between 50% and 85% relative humidity at approximately constant RH over the course of any given experiment. Glyoxal was produced photochemically from acetylene, using HONO photolysis as the OH radical source. Gas-phase glyoxal was measured by the CU LED-Cavity Enhanced-DOAS. The Thermal-Desorption Proton-Transfer-Reaction Mass Spectrometer (TD-PTR-MS) and Ion Chromatography Mass Spectrometer (IC-MS) monitored both gas and aerosol-phase organic reaction products. Particle composition was monitored by High-Resolution Time-of-Flight Aerosol Mass Spectrometry (HR-ToF-AMS), and HPLC-ESI MS/MS and LC-MS analysis of filter samples.