



Secondary Organic Aerosol Formation from Acetylene: glyoxal processing in the aerosol aqueous phase

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According to the widely established view, secondary organic aerosol (SOA) forms when semivolatile products of the gas-phase oxidation of volatile organic compounds (VOC) partition by absorption (dissolution) into an organic particle phase [Odum et al., 1997; Robinson et al., 2007]; the vapor pressure of the partitioning products decreases with the number of carbon-atoms, n , of VOC precursors. Until recently it was believed that at least $n=7$ carbon atoms are needed for a VOC to act as SOA precursor (e.g. toluene); more recent experimental results find SOA formation from benzene ($n=6$), and - in small yields - also from isoprene ($n=5$).

A series of simulation chamber experiments have been performed to study SOA formation from the OH-radical initiated oxidation of acetylene (C_2H_2), the lightest non-methane-hydrocarbon (NMHC). In all experiments SOA formation is observed. This indicates that - contrary to previous believe - there is no lower limit number of n for a NMHC to act as SOA precursor; $n=2$ here. The chemical composition of seed aerosols and relative humidity (10-90%) were systematically varied. Experiments were conducted on Ammoniumsulfate (AS), Ammoniumbisulfate (ABS), Fulvic acid (FA), Succinic acid (SucA), mixtures of AS + FA, ABS + FA, AS + humic acid (HA), AS + FA + aminoacid (AA); selected seeds were further mildly acidified (pH = 3) with sulphuric acid (SA). Further, the effect of OH-radicals and photolysis reactions on SOA formation were assessed. SOA formation is found to scale proportional to the aerosol liquid water, and is accounted to >99% by glyoxal (CHOCHO) uptake to the aqueous aerosol phase. Our results suggest that the aqueous aerosol phase presents a chemical reactor that is different to clouds, and needs to be represented explicitly in

atmospheric SOA models. The atmospheric implications are discussed.