Laboratory Studies on SOA Formation from Terpenes

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The formation of secondary organic aerosol (SOA) has been intensively investigated in recent years for the ozonolysis of terpenes. More recently, the enhancement of SOA yields from the acid catalysed reactions of organics on aerosol surfaces or in the bulk particle phase has been receiving great attention. Recent studies show that the presence of acidic seed particles increases the SOA yield significantly[1-6]. More detailed studies report the formation of higher molecular weight products in SOA[5-7] which could result in a non-reversible uptake of organics into the particle phase. FT-IR has been used in earlier studies for the structural elucidation of the enhanced SOA fractions[1-3, 8]. The FT-IR spectra lead to the suggestion that the formation of polymers by the heterogeneous reactions of aldehydes can occur in the particle phase. Application of mass spectrometry (MS) techniques has proven more detail on the nature of the particle phase oligomers[5-7]. These mass spectra typically resemble a mountain with a peak around m/z 600. Although MS spectra have proven the presence of higher mass compounds in SOA only one study[5] have attempted the separation of such compounds prior to the MS analysis and development and application of suitable separation techniques is urgently required for better characterisation and quantification of such compounds.

In the present study, particles were sampled in chamber experiments by conventional denuder-filter combinations as well as by a newly developed particle sampling device based on condensation and impaction (C-GIS). Extensive particle phase analytics were performed by capillary electrophoresis–mass spectrometry.

Most of studies in the past concentrated on the characterisation of the yields of enhanced SOA and its composition from ozonolysis of terpenes in the presence or absence of acidic and neutral seed particles. Recent findings from cyclohexene ozonolysis show that the presence OH scavengers can also greatly influence the SOA yield[9]. Our new results from the IfT chemistry department aerosol chamber on terpene ozonolysis in the presence of OH scavengers show that the presence of hydroxyl radical scavengers reduces the formation of oligomeric compounds in SOA. This result indicates that hydroxyl radicals play an important role in the formation of precursor compounds for the particle phase heterogeneous acid catalysed reactions leading to the higher molecular weight compounds and the enhancement of SOA yields. Better understanding of the role of hydroxyl radicals in the formation of SOA is necessary to distinguish between the contribution of ozonolysis and hydroxyl radicals to the SOA yield.

If the recent findings are a ubiquitous phenomenon in the atmosphere, current climate models might underestimate SOA formation yields, particle phase OC contents and its impact on the atmospheric radiation budget.

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