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Development of chromatographic methods to follow heterogeneous organic chemistry in aerosols

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Currently, there is considerable interest in the environmental effects of aerosols as they have an effect on public health, air quality and climate. From a chemical perspective, aerosol particles can support heterogeneous chemical reactions and participate in multiphase processes, which affect the distribution and abundance of atmospheric trace gases. Chemical and physical processes are some of the most poorly quantified areas of climate science and therefore represent some of the largest uncertainties in predictive climate models. Atmospheric aldol self-reactions of octanal, heptanal, and hexanal in a range of aqueous H2SO4 w/v% concentrations as a catalyst were studied in both bulk liquid-liquid experiments and gas-liquid experiments. Initially, a new practical methodology was developed and enhanced to monitor aldol reactions in aqueous acidic media. The evaluation of the quenching and extracting method was performed, confirming the suitability, reliability, and reproducibility of the extraction method. In bulk studies, aldol products of the three aldehydes were separated and identified by preparative HPLC, GC??MS, and NMR. The major aldol products observed at high acid concentrations were α, β-unsaturated aldehyde (dimer), trialkyl benzene (trimer) and tetraalkyl cyclo octa-tetra ene (tetramer). The trimer of octanal was formed as trioxane in low sulfuric acid concentration and the possible mechanism accretion reaction pathways of high and low acid concentrations are proposed in this study. A systematic kinetic study of octanal, heptanal, and hexanal in the bulk experiments at 65, 60 and 55 w/v% H2SO4 at 294K were monitored using gas chromatographic equipped with a flame ionization detector (GC??FID). The rate constants were generally estimated using second-order kinetics and observed to increase as a function of sulfuric acid concentrations and also as the chain length of aliphatic aldehyde increased. The aldol self-reaction in the bulk experiment was too fast at room temperature to be easily measured using a quenching method, therefore, attempts were made to follow the reaction at low temperature (0°C).

Biography

Ahmed M. Hameed is Assistant Professor of Analytical chemistry at Umm Al-Qura University in Makkah, KSA. His research is in three main areas: the first is the development of methods to directly observe fundamental gas phase kinetics of key reactions of atmospheric importance in the laboratory. The second area of work focuses on the development of novel analytical techniques to quantify trace species in the atmosphere and the third area is on the investigation of trace elements in drinking water. He is also teaching analytical and environmental chemistry modules.

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