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Atmospheric Chemistry of Acenaphthalene and Acenaphthylene

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Polycyclic aromatic hydrocarbons (PAHs) are released into the atmosphere as a by-product of combustion processes and have been detected in ambient air at urban locations around the world. In the atmosphere, PAHs containing two and three rings are found predominantly in the gas-phase, whilst those containing six or more rings principally adsorb to particles. PAHs with four or five rings are found in both phases. The gas-phase PAHs can be chemically transformed in the lower troposphere via reaction with hydroxyl (OH) and nitrate (NO3) radicals and ozone. These reactions lead to the formation of a range of oxidation products including phenols, nitro-PAHs and carbonyls, in addition to other pollutants such as ozone and secondary organic aerosol (SOA).

Despite their importance, relatively little is known about the atmospheric chemistry of the PAHs, mainly because of the difficulty of working with these compounds and also the variety and complexity of the reaction products formed. Up to now only one kinetic study on the reaction of acenaphthalene and acenaphthylene with OH, NO3 and ozone has been reported in the peer-reviewed literature. In this study, we have determined rate coefficients for the gas-phase reactions of acenaphthalene and acenaphthylene with OH, NO3 and ozone using the relative rate method. The results are compared with previous measurements and used to provide estimates of the tropospheric lifetimes of these compounds. A recently developed denuder-filter sampling technique was used to investigate the gas and particle phase products arising from the photooxidation of the PAHs. Chemical analysis was performed using gas chromatography – mass spectrometry using O-(2,3,4,5,6- pentafluorobenzyl)-hydroxylamine (PFBHA) and pentafluorobenzyl bromide (PFBBr) as derivatizing agents for carbonyls and phenols respectively. The results provide new data on the gas-particle partitioning behavior of the oxidation products and useful information on the products likely to be involved in secondary organic aerosol formation from the PAHs.