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Heterogeneous reactions of HO_2 with a variety of aerosol types. Effects of transition metal ions and irradiation

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The lifetime of HO_2 is sufficiently long that uptake to aerosols may constitute an important component of its budget, yet quantitative comparisons of field-measured and modelled concentrations have been hampered by uncertainties in the uptake coefficient (γ) of HO_2 to aerosols. An aerosol flow tube coupled with very sensitive detection of HO_2 has been used to determine γ for HO_2 onto a wide range of aerosol types including inorganic salt aerosols, dusts (terrestrial and cosmic), single component organic aerosols (including surfactants and sucrose), and secondary organic aerosol. The injection of the latter into the stratosphere has been suggested as one strategy to mitigate global warming, and the application of TiO_2 coatings to surfaces within the urban environment is used to remove NO_2 resulting from traffic emissions and to facilitate self-cleaning. Uptake coefficients were determined as a function of relative humidity (RH), transition metal ion concentration, aerosol viscosity and temperature.

Uptake coefficients were determined for sub-micron TiO_2 particles as a function of RH. Significant uptake was observed in the dark, with γ = 0.021 $\pm$ 0.001 for RH=11%, increasing with RH and apparently dependent upon the number of monolayers of water adsorbed onto the TiO_2 surface. When the TiO_2 particles were illuminated with near-UV radiation (365 nm) significant production of HO_2 radicals was observed, displaying a complex dependence upon radiation flux, RH and total particle surface area. When inorganic salt aerosols were generated in the presence of transition metal ions (copper, iron and manganese, either studied singly or as mixtures), the removal of HO_2 was catalyzed leading to an increase in γ, which was observed to be a complex function of the concentration of the free, uncomplexed ions.