Heterogeneous interaction of SiO$_2$ with N2O5: single particle optical levitation-Raman spectroscopy and aerosol flow tube studies

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The heterogeneous reaction of SiO$_2$ with N2O5 was investigated at room temperature and different relative humidities (RH). The uptake coefficient of N2O5 onto airborne sub-micrometre SiO$_2$ particles, $\gamma$(N2O5), was measured using an atmospheric-pressure aerosol flow tube. $\gamma$(N2O5) was measured to be (4.8±0.4)×10$^{-3}$ at 7% RH and (3.5±0.5)×10$^{-3}$ at 40%, probably suggesting a slightly negative dependence on RH. In contrast, Raman spectroscopy measurements of the singles particles during the exposure to N2O5 show that the amount of nitrate formed on the particles increases with RH, and that nitrate formed on the particles can be entirely removed when the RH is reduced to 0%. The results suggest that nitric acid formed in the heterogeneous hydrolysis of N2O5 on the SiO$_2$ surface can partition in both the gas phase and particulate phase, and the RH determines the partitioning. The atmospheric implications for photochemistry and aerosol aging processes will also be discussed.