The effect of dissolved ions on uptake coefficient of propene-derived RO_2 onto NaCl particles

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Tropospheric ozone (hereinafter name as ozone) is the main component of photochemical oxidants, which is produced through photochemical reactions involving volatile organic compounds (VOCs) and nitrogen oxides (NOx = NO + NO_2). In Japan, ozone concentration has been slowly increasing since the 1980s, despite a decrease in its precursors. It was suggested that the decrease of aerosol concentration will associate with air quality improvement, which may constrain the heterogeneous reactions between gases and particles and further stir ozone production. Therefore, it is important to understand the ozone production mechanism from the perspective of heterogeneous reactions for prediction of air quality. HOx cycle, also known as radical chain reaction (OH→RO_2→HO_2→OH), is vital for ozone production mechanism. Research reported the removal of OH and HO_2 radicals due to heterogeneous reactions with aerosol particles (in short, uptake process) has been accumulated. To quantitatively evaluate the ozone production suppression effect by uptake onto aerosols, the uptake coefficient (γ) is necessary, especially the γ of RO_2 radicals has not been reported due to technical difficulties.
In this study, we used LP-LIF (Laser Photolysis-Laser Induced Fluorescence), as a new method to measure γ of propene-derived RO_2 radicals onto NaCl particles and also to investigate the effect of each dissolved ion on uptake. In the experiments, the LP-LIF system was used to measure the loss rate of radicals from the gas phase by particles, and SMPS (Scanning Mobility Particle Sizer) was used to measure particle total surface area. Sampling particles were generated by nebulizing aqueous NaCl solutions and aqueous NaCl solutions with sodium ascorbate, copper(II) chloride tetrahydrate, or iron(II) chloride dihydrate at 5% of the NaCl weight, respectively. All experiments were conducted under humid conditions with about 85% relative humidity and at room temperature. Ascorbate and iron (II) ions were found to promote the uptake of RO_2 radicals. However, the effect of copper (II) ions was not obvious. In particular, the fact that iron (II) ions are present in the atmospheric particles suggests that the uptake enhancement by iron (II) ions may be unignorable in the real atmosphere.

Keywords: tropospheric ozone, HOx cycle, uptake coefficient, RO2 radicals

