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Real time tracing of the kinetic process of NO_3, N2O5 and NO_2 with VOCs by long optical pathlength absorption spectroscopy

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Nitrate radical (NO_3) and dinitrogen pentoxide (N2O5, formed through the reaction of NO_3 with NO_2 and is a large reservoir for NO_3) are two key intermediates components in atmospheric nitrogen chemistry [1]. They affect directly the oxidation capacity of the atmosphere through reaction of NO_3 with volatile organic compounds (VOCs). It's highly desirable to be able to perform in-situ, simultaneous and continuous monitoring of NO_3 and N2O5 concentrations with high selectivity and fast response time. N2O5 is usually indirectly measured via optical measurement of NO_3 after thermal dissociation of N2O5 to NO_3 [2]. In this paper, we report on the recent development and application of optical method for in situ direct concentration measurements of NO_3 and N2O5 in smog chamber. NO_3 (as well as NO_2) were simultaneously measured by open-path incoherent broadband cavity enhanced absorption spectroscopy (IBBCEAS) [3] based on a light emitted diode operating in the range of 635-675 nm, and N2O5 was monitored by means of open-path multi-pass absorption spectroscopy of an external cavity quantum cascade laser tunable from 1223 to 1263 cm-1 ($\sim$8 μm). Reaction of NO_3 with VOCs (such as isoprene, formaldehyde, 2-methoxyphenal) as well as the equilibrium between NO_3 and N2O5 during the VOCs oxidation by NO_3 radical have been on-line traced with high temporal resolution: 1 s for NO_3-NO_2 and 25 s for N2O5. Experimental detail and preliminary results will be presented. Our present work demonstrated that modern photonic technologies can provide a direct and highly selective means for chemical kinetic study, for instance, bringing insight into reactive uptake for NO_3 and N2O5 on the organic particles [4], which remain still unexplored with few exceptions.

References

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