Real-time measurement of HO_2 and RO_2 uptake loss rate onto ambient particles during AQUAS-Kyoto summer campaign in 2020

*Yosuke Sakamoto[1,2], Bai Yu[1], Jiaru Li[1], Kohno Nanase[1], Yoshizumi Kajii[1,2]

1. Kyoto University , 2. National Institute for Environmental Studies

Peroxy radicals, HO_2 and RO_2, play a central role in the daytime photochemistry in the troposphere, since they compose daytime radical recycling chain reaction through OH →RO_2 →HO_2 →OH, namely HO_x cycle, which dominate tropospheric O_3 formation. The gas phase reactions of peroxy radicals that produce non-radical species, e.g. HO_2 + HO_2 →H_2O_2 + O_2, HO_2 + RO_2 →ROOH + O_2, work as termination reaction of the HO_x cycle, and thus affect efficiency for O_3 formation. It has been suggested indirectly for decades that HO_2 uptake by ambient particles also work as termination process based on laboratory experiments with artificially produced particles. Recently, we achieved real-time measurement of HO_2 uptake kinetics onto ambient particles and reported the HO_2 loss rate and uptake coefficient for ambient particles during AQUAS-Kyoto summer campaign in 2018. [Zhou et al. 2020] In this study, we examined HO_2 uptake kinetics onto ambient particles in Kyoto again during AQUAS-Kyoto summer campaign in 2020, with the aim of investigating temporal variation of uptake kinetics from previous campaign. Additionally, we expanded the system to real-time measurement of isoprene-derived RO_2 (C_5H_8(OH)OO) uptake kinetics onto ambient particles. Daily average of HO_2 loss rate was similar but uptake coefficient was smaller compared with previous campaign. Observed loss rate was comparable to those of gas phase termination reactions. Temporal variation of aerosol components might be possible explanation of variation of uptake coefficient during the present campaign and difference from the previous campaign. We found that daily average of RO_2 loss rate and then uptake coefficient had significant values. Observed loss rate for RO_2 was also comparable to those of gas phase termination reactions as well as HO_2. Our results suggest that further investigations of not only HO_2 but also RO_2 uptake kinetics are required for complete understanding of O_3 formation in the troposphere.

Reference: Zhou et al. *Atmospheric Environment*, 223 (2020) 117189.
Acknowledgements: This work was supported by the Japan Society for the Promotion of Science (JSPS NO. 16H06305 and NO. JP19H04255). We would like to thank the technical support from KIMOTO ELECTRIC CO., LTD. in construction of aerosol enrichment system.

Keywords: heterogeneous reaction, aerosol, PM2.5, photochemical ozone, HOx cycle

