Geophysical Research Abstracts
Vol. 20, EGU2018-4060, 2018
EGU General Assembly 2018


# A hydroxyl radical detection system based on free jet expansion and laser-induced fluorescence techniques

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Hydroxyl (OH) radical is the most potential oxidant agent in the atmosphere. An OH radical measurement instrument based on laser induced fluorescence (LIF) has been developed in our laboratory. Gas sampling is based on supersonic free jet expansion and ambient air is introduced into a low-pressure fluorescence cell through a pinhole aperture, then the OH radical is irradiated by a tunable dye laser at a high repetition rate of 8.5 kHz. Considering the extremely weak irradiation and short lifetime of the fluorescence, time resolved technique was used for its measurement. A self-designed gated photomultiplier (PMT) is used, and gating is actualized by switching the voltage applied on the first, third and fifth dynodes of the PMT, with a rising time of 20 ns and the on/off gain (extinction) ratio better than $10^5$. Then the weak signal is accumulated by a photon counter in a specific timing after laser ends. The calibration of the LIF system is researched in a quartz flow tube and certain concentration of OH radical is produced by simultaneous photolysis of $H_2O$ and $O_2$. The minimum detection limit of the instrument using gated PMT is determined to be $9.4\times10^5$ molecules/cm$^3$, and the sensitivity is $9.5\times10^{-7}$ cps/(OH·cm$^{-3}$)(S/N=2, integration time=60s). And a micro channel photomultiplier (MCP) is also prepared for fluorescence detection, while OH detection limit and the detection sensitivity using MCP is $1.6 \times 10^5$ molecules/ cm$^3$ and $2.3 \times 10^{-6}$ cps/(OH·cm$^{-3}$), respectively. Some filed measurement of atmospheric OH radical has been carried out, and the diurnal variation of OH radical concentration is obtained.