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Measurement of OH radicals using off-axis integrated output spectroscopy (OA-ICOS) at 2.8 µm

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The hydroxyl (OH) free radical plays an important role in atmospheric chemistry due to its high reactivity with volatile organic compounds (VOCs) and trace species (CH_4, CO, SO_2, etc) [1]. Due to its very short lifetime (~1 s or less) and very low concentration in the atmosphere (in the order of 10^6 cm^{-3}), in situ and direct measurement of OH concentration in the atmosphere is challenging [2].

We report in this paper our recent work on developing a compact spectroscopic instrument based on off-axis integrated cavity output spectroscopy (OA-ICOS) [3] for optical monitoring of OH radicals. In the present work, OH radicals of ~10^{12} OH radicals/cm^3 were generated from continue micro-wave discharge at 2.45 GHz of water vapor at low pressure (0.2-1 mbar), and were used as sample for validation of the developed OA-ICOS approaches. Two experimental approaches are designed for the measurements of OH radicals: (1) OA-ICOS [4] and wavelength modulation enhanced OA-ICOS (WM OA-ICOS) [5]. A distributed feedback (DFB) laser operating at 2.8 µm was employed for probing the Q (1.5e) and Q (1.5f) double-line transitions of the $^2\Pi_{3/2}$state at 3568.52382 and 3568.41693 cm^{-1}, respectively. A 1s detection limit of ~2.7×10^{10} cm^{-3} was obtained for an averaging time of 125 s using a simple OA-ICOS scheme. This limit of detection is further improved by a factor of 3.4 using a WM OA-ICOS approach.

The experimental detail and the preliminary results will be presented and discussed.

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