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Infrared Faraday Rotation Spectroscopy for Monitoring of the atmospheric oxidation capacity

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Hydroxyl (OH) free radical is a key oxidizing species in the Earth's atmosphere. Because of its high reactivity, interference-free high sensitivity *in situ* monitoring of OH represents a real challenge. Faraday rotation spectroscopy (FRS) takes advantage of the particular magneto-optic effect observed for paramagnetic species. When a longitudinal magnetic field is applied, the magnetic circular birefringence is observed in the vicinity of Zeeman splitted absorption lines, and the polarization axis of a linearly polarized light is rotated due to interaction with the sample. This makes FRS capable of enhancing the detection sensitivity and completely eliminating interference from the diamagnetic species in the atmosphere such as CO_2 and H_2O. For OH free radicals, the highest absorption line strength and the largest g_J value make the Q (1.5) double lines of the $^2\Pi_{3/2}$ (υ=1←0) state at 2.8 μm clearly the best choice for sensitive detection in the infrared region by FRS. In this paper we report on the development of an FRS instrument based on a DFB diode laser operating at 2.8 μm. The prototype instrument with an active optical pathlength of only 25 cm and a lock-in time constant of 300 ms, achieves a 1σ detection limit of 3.5×10^{10} radicals/cm^3. Substantial improvements of the instrumental components are currently ongoing and will be reported in details. Based on the conservative estimates the detection sensitivity of $\sim10^7$ radicals/cm^3 can be attained which is suitable for high accuracy atmospheric chemistry studies in environmental photoreactor chambers and for direct measurement of total reaction rate of OH in the atmosphere under atmospheric pressure.