Near Infrared Spectroscopy of DONO and Simultaneous Detection of HONO, HNO_3 and NO_2 by Fourier Transform Incoherent Broadband Cavity-Enhanced Absorption Spectroscopy

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Incoherent broadband cavity-enhanced absorption spectroscopy (IBBCEAS) [1] combines the flexibility of a wide spectral window with the sensitivity provided by cavity-enhanced absorption methods. Combined with Fourier transform spectroscopy, the technique offers higher spectral resolution in contrast to the conventional IBBCEAS methods [2]. In this work, FT-IBBCEAS has been employed to measure the $2\nu_1+\nu_3$ and $3\nu_1$ bands of the trans- and cis-isomers of deuterated nitrous acid (DONO) [3, 4] for the first time in the near infrared wavelength region between 5500 and 8000 cm^{-1}. All bands were rotationally resolved, yielding spectroscopic constants with good accuracy. Additionally, several bands of HONO, HNO_3 and NO_2 have been detected simultaneously across the NIR spectral range, demonstrating the potential of the method to detect multiple trace gases simultaneously through their known line positions. The rotational analysis of the $\nu_1+2\nu_3$ combination band of HNO_3 [5] near 6140 cm^{-1} will also be presented.

HONO is well-known for its role as precursor of the hydroxyl radical (OH), the most important daytime oxidant in the atmosphere. The mechanisms of HONO formation in the troposphere are still not entirely understood [6,7]. One major formation pathway of HONO is the heterogenous hydrolysis of NO_2, forming HNO_3 as a by-product [8]. Thus the simultaneous measurement of these species can become a helpful tool for the investigation of the gas phase chemistry of HONO.

References

[1] Fiedler, S.E., Hese, A., Ruth, A.A., *Chem. Phys. Lett.*, **371** (2003) 284.
[2] Orphal, J., Ruth, A.A., *Opt. Express*, **16** (2008) 19232.
Ruth, A.A., Orphal, J., Fiedler, S.E., *Appl. Opt.*, **46** (2007) 3611.
[3] Halonen, L.O., Deeley, C. M., Mills, I.M., Horneman, V.–M., *Can. J. Phys.*, **62** (1984) 1300.
[4] Dehayem-Kamadjeu, A., Orphal, J., Ibrahim, N., Kleiner, I., Bouba, O., Flaud, P.–M., *J. Mol. Spectrosc.*, **238** (2006) 29.
[5] Cox, A.P., Riveros, J.M., *J. Chem. Phys.*, **42** (1965) 3106.
[6] Calvert, J.G., Yarwood, G., Dunker, A.M., *Res. Chem. Intermed.*, **20** (1994) 463.
[7] Finlayson-Pitts, B.J., Wingen, L.M., Sumner, A.L., Syomin, D., Ramazan, K.A., *Phys. Chem. Chem. Phys.*, **5** (2003) 223.
[8] Ramazan, K.A., Syomin, D., Finlayson-Pitts, B.J., *Phys. Chem. Chem. Phys.*, **6** (2004) 3836.