Geophysical Research Abstracts,
Vol. 11, EGU2009-12217, 2009
EGU General Assembly 2009

Cavity Enhanced Absorption Spectroscopy with a red LED source for NOx trace analysis

I. Ventrillard Courtillot, E. Sciamma O'Brien, G. Méjean, and D. Romanini

Laboratoire de Spectrométrie Physique, CNRS UMR 5588, Université J. Fourier de Grenoble, Saint Martin d'Hères, corresponding author : irene.ventrillard@ujf-grenoble.fr

This study presents a high sensitivity absorption system using a red LED source emitting at 625 nm and a small CCD spectrometer as detector [1]. This system is based on IBB-CEAS (Incoherent Broad Band Cavity Enhanced Absorption Spectroscopy). The expected application is the measurement of NO2 and NO3 in urban concentration (ppbv and ppmv levels). The IBB-CEAS was firstly developed with arc lamps and then with LED. Systems based on this technique are easy to use, highly sensitive, compact and robust. They also are inexpensive. Existent techniques to measure NO2 and NO3 are generally slow or not sensitive enough and need frequently calibrations (chemical luminescent) or are characterized by a low spatial resolution (Long Path Differential Optical Absorption Spectroscopy).

Previous works based on diodes lasers emitting around 410 nm and coupled with High Finess Cavity proved a highest sensibility than ppbv and a time measurement of 0.1 s [2]. This sensibility is necessary for measurements in unpolluted environment but a more expensive and more complex system is needed. NO2 is chosen for testing as it is stable and available in calibrated diluted samples. An excellent agreement in the range from 610 nm to 630 nm was gotten between an absorption spectrum obtained by IBB-CEAS and a spectrum calculated using a reference NO2 absorption cross section by Voigt et al [3] (after convolution with a 2.05-nm FWHM Gaussian simulating our spectrometer response function). The reflectivity of the mirrors was determined with a commercial spectrophotometer and was used to deduce the absorption spectrum of NO2 from the transmission spectrum of the cavity. We obtained by estimating the sensitivity of our setup from the noise in a baseline measurement of absorption, (standard deviation = 2E-10 cm-1). This corresponds (under atmospheric conditions) to a sensitivity about 0.5 ppbv. NO3 cross-section absorption is 600 times higher than the NO2 (at 623 nm), so a detection limit of 1 pptv is expected for NO3. Thus the developed system is suitable for atmospheric urban concentration of NO2 and NO3.

[1] M. triki, P. Cermak, G. Méjean, and D. Romanini, Appl. Phys. B 91, 195 (2008).
[2] I. Courtillot, J. Morville, V. Motto-Ros and D. Romanini, Appl. Phys. B 85, 407 (2006)
[3] S. Voigt, J. Orphal, and J. Burrows, J. Photochem. Photobiol. A 149, 1(2002).