Geophysical Research Abstracts, Vol. 9, 11646, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-11646

Novel Multi-Purpose Sensor for Atmospheric Monitoring Using Nd:YAG Laser Based Multi-wavelength Photoacoustic System

T. Ajtai (1), Á. Filep (1), A. H. Veres (1), G. Motika (3), Z. Bozóki (2), G. Szabó (1)

(1) Department of Optics and Quantum Electronics, University of Szeged, Hungary, (2) Research Group on Laser Physics of the Hungarian Academy of Science, University of Szeged, Hungary, (3) Lower Tisza Valley Environmental Inspectorate, Szeged, Hungary.(ajtai@titan.physx.u-szeged.hu / Phone: +36 62 544 285)

The quantification and qualification of atmospheric compositions find application in such diverse field as environmental monitoring, health and climate forcing. An ultra-sensitive chemical analysis of gas and aerosol based on the optical method from the UV to the IR region is a well established approach. The requirements of such an instrument for aerosol monitoring are as follows: high sensitivity (with the detection limit below 1ìg/m3 in aerosol, ppb range in ozone and NO2 concentration), selectivity (free from the cross sensitivity caused by the light scattering and filter matrix used for particle enrichment), fast response time (avoid the long-term filter sampling required for concentrate atmospheric soot for thermal analysis), portability. Presently, number of techniques has been developed for aerosol monitoring, but none of them are able to fulfil all of these requirements. The approach of combining the advantages of multi-wavelength light sources and the photoacoustic detection scheme is very promising, providing response time below one minutes, insensitivity for scattering molecules and particles, free from cross sensitivity as well as relatively small dimension of the presented system.

In this work we are demonstrating a multi purpose photoacoustic sensor for atmospheric monitoring based on the diode laser pumped, high repetition rate, Q-switched Nd:YAG laser and its frequency converted high harmonics. It is designed to make an in situ measurement at three wavelengths (1064nm, 532nm and 266nm) simulta-

neously. The three wavelengths are generated via frequency doubling (532nm) and quadrupling (266nm) of the fundamentals of Nd:YAG laser (1064nm) by means of nonlinear crystals (LBO, BBO). Because of the ozone is being the primary absorber of the UV region and the absorption coefficient at 254nm just slightly different than at 266nm, the fourth harmonic of Nd:YAG is suitable for ozone monitoring in the ppb range. The second harmonic (532nm) is one of the best candidates for NO2 monitoring in ppb range sensitivity. The wavelength gap and the different absorption coefficient between these three wavelengths are sufficient to take distinction between the main carbonaceous fractions: organic carbon (OC), black or elemental carbon (BC or EC) and inorganic carbon (e.g. carbonates).

The present system was successfully tested and compared with a large set of recently developed or common instrumentation both under the laboratory and field circumstances. The results of these studies indicate that this sensor has the potential to characterise different minerals (Illit, Kaolinate, Hematite), different type of dust and make the difference between soot arises from traffic and from domestic wood burning.

These researches were funded by the OTKA Foundation (TS49872) and by the Hungarian Ministry of Economy and Transport (GVOP-3.1.1-2004-05-0302/3.0), the Hungarian Ministry of Education (NKFP-3A/046/2004 and 3/021/2005).