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Novel Multi-Purpose Sensor for Atmospheric Monitoring Using Nd:YAG Laser Based Multi-Wavelength PhotoAcoustic System (MuWaPAS):laboratory and field test.

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Presently, there are several commercially used equipment monitoring the compositions of the atmosphere, but thanks for the continuously increasing concern of atmospheric research field there is a big demand not just for the continuously improvement of the already available systems but for newly developed measurement methods and equipment to suit updated requirements and demands. Several commercially used method and equipment for monitoring the pollution molecules such as ozone and NO_2 and also for monitoring the particles such as carbons (black carbon or elemental carbon, organic and inorganic carbon), mineral dust and so on have been available for decades. None of them fulfil all of the following requirement.

For optical characterisation of aerosols

Determine directly the optical absorption coefficients of aerosols.

Determine the optical absorption of aerosols in wide wavelength range at several wavelength (from the deep UV to NIR) simultaneously.

Source apportionment capabilities

high sensitivity, high selectivity, fast response time, mobility.

For pollution molecules:

Ppb sensitivity for ozone and NO_2 molecules

Ozone flux measurement capabilities

High selectivity, fast response time mobility, integrated system

In I this work, we are demonstrating a novel Multi Wavelength PhotoAcoustic System (MUWAPAS) for simultaneously monitoring the various type of atmospheric composition based on the diode laser pumped, high repetition rate, Q-switched Nd:YAG laser and its frequency converted high harmonics.

This system is proved to be very promising, providing the detection limit in the order of $1\mu g/m^3$ in aerosol, in a ppb range for ozone and NO_2 concentration, a time resolution below one minute, insensitivity of scattering particles as well as relatively small dimension of the portable developed system. It is designed to make an *in situ* measurement at four wavelengths (1064nm, 532nm, 355nm and 266nm) simultaneously. The four wavelengths are generated via frequency doubling (532nm), mixing (355nm) and quadrupling (266nm) of the fundamentals of Nd:YAG laser (1064nm) by means of nonlinear crystals (LBO, BBO). The second (532nm) and the fourth (266nm) harmonic of the fundamental are used for monitoring NO_2 and O_3 molecules. All the four wavelengths are used for aerosol characterisation of atmospheric air. Thanks for the wide wavelength range, the filter free sampling method and the scattering insensitivity of the photoacoustic detection scheme the combination of this unique light source and photoacoustic detection method is one of the best candidate for optical absorption characterisation and source apportionment of aerosols.

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 studied, demonstrated here, is indicate that this instrument 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.

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