A DIODE LASER BASED SPECTROMETER FOR IN-SITU MEASUREMENT OF VOLCANIC GASES

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Chemical analysis of fumarolic gases released in volcanic areas may provide crucial information on magmatic processes. In-situ sampling techniques such as gas chromatography and mass spectrometry result often impractical or dangerous, and do not allow temporally continuous monitoring.

This is the reason why, in recent years, optical remote-sensing methods have enjoyed great development.

Meanwhile, the great progress in opto-electronic technologies, in the last decades, has increased the use of optical components, formerly developed for telecommunications, in gas monitoring applications. In particular, optical communication diode lasers, which emit visible and IR radiation with mW power, operating on single mode at room temperature, are ideal sources to develop high sensitivity gas analysers based on absorption spectroscopy techniques. Their possible use in conjunction with fiber components is particularly advantageous for environmental and industrial monitoring applications, especially considering that an ideal volcanic sensor should operate unattended and remotely, over long time periods.

We report on the first field tests of a novel Portable Diode Laser Spectrometer (PDLS), operating at a wavelength of 1.99µm and based on direct absorption spectroscopy, for high precision, accurate and real-time, simultaneous measurements of CO$_2$ and H$_2$O concentrations. A field campaign was performed, in July 2002, in the fumarolic area of the Pozzuoli Solfatara crater, near Naples, and in the Island of Vulcano, belonging to the Eolian Archipelago, north of Sicily (Italy). The former site is very close to one of the most active bradyseismic areas in the world; the latter is one of the three presently active Italian volcanoes, with gaseous emission from a wide field of fumaroles, not
only in the crater area.
In both cases we employed an open-path configuration, positioning the detection bench, equipped with a a Herriott cell especially projected for measurements in hazardous environment, at different sites of the fumarolic areas. With such a configuration we can take advantage of the long optical path-length allowed by the multiple-pass cell (20.3m).
The CO₂ and H₂O concentrations vs. time measured are shown.
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