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Performance Of An Isotope Ratio Infrared Spectrometer For Simultaneous Measurements Of Carbon And Oxygen Isotopologues Of CO$_{2}$

Hans-Juerg Jost (1), Eric Wapelhorst (2), Hans-Juergen Schlueter (2), Oliver Kracht (2), Jens Radke (2), Andreas Hilkert (2), Johannes A.C. Barth (3), Robert Van Geldern (3), Martin E. Nowak (4), Martin Zimmer (5), and Alexandra Szizybalski (5)

(1) Thermo Fisher Scientific, Reinach, Switzerland (hj.jost@thermofisher.com), (2) Thermo Fisher Scientific, Bremen, Germany, (3) Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany, (4) now at Max Planck Institute for Biogeochemistry, Jena, Germany, (5) Deutsches GeoForschungsZentrum GFZ, Potsdam, Germany

Laser-based Isotope Ratio Infrared Spectrometers (IRIS) offer the potential to perform precise, continuous, in-situ monitoring of isotopologues of trace gases at ambient concentrations. We present a middle-infrared laser-based sensor platform that is capable of simultaneously determining both δ^{18}O and δ^{13}C isotope ratios of carbon dioxide. Specifically, we access the fundamental bands of CO_2 at 4.2 microns using a difference frequency generation (DFG) laser combined with a simple, direct absorption approach that makes use of a robust multi pass cell and a cryogen free setup.

The performance of the analyzer has been assessed in the laboratory by diluting a CO_2 gas of known isotopic composition at different rates of concentration change. Precision $< 0.05‰$ for both δ^{13}C and δ^{18}O has been achieved for changes of 75 ppmV per hour. At an increased rate of concentration change of 40 ppmV per min, the precision was $<0.15‰$ for δ^{13}C and δ^{18}O. In both cases the accuracy was within the analytical precision and better than $0.05‰$.

The analyzer is suited for, but not limited to, Greenhouse Gas Monitoring, Plant Science and Ecology, monitoring of volcanic gases, and Carbon Sequestration and Storage (CCS) research. We present field data from the Ketzin pilot site near Berlin, Germany. The analyzer was used to continuously sample the gas emanating from a test well while at the injection well an isotopically heavier gas was injected. The device was able to precisely observe the arrival of this isotopically different gas in the test well.