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Laser based technique for CO_2 flux measurements

Danijela Smajgl and Magda Mandic
Thermo Fisher Scientific, Bremen, Germany (danijela.smajgl@thermofisher.com)

The isotopic composition of CO_2 has been widely used for studying ecosystem gas exchange. The carbon isotope ratio and oxygen isotope ratio of atmospheric CO_2 (δ13C; δ18O) can be used to partition the gross fluxes of CO_2 in terrestrial ecosystems, such as plant respiration, soil respiration, and plant assimilation, as well as a tool for studying ocean-atmosphere interactions.
The characteristic δ13C value is modified by plant metabolism and photosynthesis, while the δ18O is affected by the oxygen exchange between the molecules of CO_2 and H_2O which originate from different water pools.

Here we present a new possibility for monitoring of CO_2 fluxes, Thermo Scientific™ Delta Ray™ spectrometers. Instrumentation is based on direct absorption spectroscopy and it uses mid-infrared laser that operates at 4.3 μm. The laser scans over the spectral region containing four CO_2 absorption lines and isotope ratios are calculated from the spectrum fit. Calculation of different CO_2 isotopologues and determination of stable isotope ratios from spectrum is possible due to absorption lines which are shifted relative to each other. In direct absorption laser spectroscopy, the calculated isotope ratios are highly dependent on the CO_2 concentration. Therefore, for maximal accuracy of the measurements, instrument has a possibility to adjust the concentration of reference gas to match the concentration of the sample gas. This technology enables the simultaneous determination of δ13C, δ18O and CO_2 concentration with a precision better than 0.05‰Ẇith measurement resolution of seconds, it is a great tool for monitoring quick changes in open systems and provides new insights into CO_2 fluxes.