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Online Compound-Specific δ13C and δD Determinations Using Laser Spectroscopy

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A unique laser spectroscopic approach for making online high-precision compound-specific isotope analysis (CSIA) of both δ13C and δD of the CO_2 and H_2O organic combustion products is described. The system consists of a gas chromatograph (GC) for the separation of an organic mixture coupled to a novel micro-fabricated microreactor (MFMR) for the complete combustion of each organic compound into CO_2 and H_2O and the precise measurements of δ13C in the CO_2 gas and δ2H in the H_2O vapor from the well established infrared spectrum of both gases, using an isotopic CO_2 Cavity Ring-Down Spectroscopy (CRDS) analyzer and an isotopic H_2O vapor CRDS analyzer, respectively. Light hydrocarbons are used as our test compounds in this study. The analyses of CH4, C2H6 and C3H8 for δ13C and δ2H values resulted in precisions of SD(δ13C)<1‰ and SD(δ2H)<2‰ respectively. These results were further compared to the gold standard method using Dual Inlet IRMS (DI-IRMS) and showed excellent agreements in isotopic measurements. The preliminary results presented here pave the way for a single CRDS analyzer-based system that simultaneously measures δ13C and δD, is field-deployable, less costly and necessitates less operator expertise than IRMS-based systems.