



Metrology for laser spectroscopic concentration and isotope ratio measurements of atmospheric greenhouse gases

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Continuous, accurate and precise measurements of greenhouse gases (GHG) and their isotopic composition are required to understand the global cycle as well as source and sink processes of these environmentally harmful substances. Part of the EMRP project HIGHGAS (Metrology for high-impact greenhouse gases) [1] focuses on spectroscopic methods for GHG isotopic composition measurements and optical transfer standards. Harmonization of terminologies and concepts used in the GHG measurement communities and the metrology community are in focus, especially for isotope ratio measurements by laser spectroscopy, where gas metrology is still at an early stage. The focus of the HIGHGAS project here is on $^{13}\text{C}/^{12}\text{C}$ and $^{18}\text{O}/^{16}\text{O}$ ratios in CO_2 , $^{15}\text{N}/^{14}\text{N}$ ratios in N_2O and $^{13}\text{C}/^{12}\text{C}$ and $2\text{H}/1\text{H}$ ratios in CH_4 . As an alternative and complement of gas mixture standards, optical spectroscopic transfer standards for CO_2 and CO shall be developed providing concentration results that are directly traceable to the international system of units (SI). Optical transfer standards offer an alternative in situ calibration route for other GHG measurement devices operating in the field. An optical transfer standard becomes particularly interesting when measuring sticky or reactive gases where cylinder-based reference gas mixtures may not be feasible.

We present an approach to perform IR-spectrometry on gases with results directly traceable to the SI. This is crucial for the development of optical spectroscopic transfer standards providing SI-traceability to field measurements. Ideas for spectroscopic isotope ratio measurements aiming at SI-traceability will be discussed. Finally, we demonstrate the current performance and limitations of our measurement approaches and project possible solutions.

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References

[1] EMRP project ENV52-HIGHGAS (Metrology for high-impact greenhouse gases), available at: <http://www.euramet.org/>