QUANTITY DETERMINTATION AND TRACEABILITY FOR SUPER-RESOLUTION MID-INFRARED LASER ABSORPTION SPECTROSCOPY

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Super-resolution spectroscopy is essential for the understanding of molecular fine structures, excited state population, distribution function of given energy states, and remote sensing applications. We addressed several key measures for achieving high performances of sprectal resolution and absorbance precision in a mid-infrared modulated laser spectrometer with a distributed feedback interband cascade laser, including linearization of laser scanning, suppression or deduction of optical fringe interferences, and internal calibration for baseline problems and nonlinear response of the photodiode used in the system. The performances of our modified spectrometer were verified with the spectral resolution in the order of 10-6 cm-1 (h̃undreds kHz) and absorbance uncertainty in the order of 10-3. We provided a detailed error analysis with the uncertainty model of GUM, i.e. Guide to the expression of uncertainty in measurement. Further, we ensured the traceability of the spectrometer by linking a practical calibration reference standard. We measured the fundamental absorption of several organic molecules, e.g. dimethyl sulfide (CH3)2S), methyl mercaptan (CH3SH) with our modified spectrometer. The recorded spectra were demonstrated to be similar to that in the Pacific Northwest National Laboratory (PNNL) database. These data have been used in our remote sensing applications.