A NEW INSTRUMENTATION FOR SIMULTANEOUS THZ AND MID-IR QUANTITATIVE SPECTROSCOPY IN CORROSIVE GASEOUS MIXTURES

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For precise laboratory measurements of infrared absorption intensities and line profiles of molecules of relevance for atmospheric chemistry in planetary and upper earth atmospheric layers, precise measurements between 10^{-3} and a few mbars in the 200 to 300 K temperature range are necessary. For some gases, such as nitrous or hypobromous acids which always appear in complex chemical equilibria, one cannot, however, rely on absolute pressure measurements to measure optical absolute integrated absorption cross sections or infrared line intensities.
An original experimental development is described here, involving the simultaneous use of two instruments: a dual-beam Mid-IR/THz experiment. We have built a new coolable cell (200-300 K), made of inert materials, combining mid-infrared and THz absorption channels for measurements on the same gaseous sample at the same temperature. The THz channel records pure rotational lines of these unstable molecules, for which the dipole moment is previously known at high precision from Stark effect measurements. This enables a precise (better than 10%) computation of the partial pressure within the gaseous mixture and using this information for retrieving absolute line intensities for the Mid-IR range, useful for remote sensing of the atmosphere.
This new instrument opens up the way for many experiments in quantitative spectroscopy by improving the precision of spectroscopic parameters for unstable molecules of atmospheric interest, which only exist in the laboratory in a mixture characterized by chemical equilibrium. The design and performance of the equipment are briefly presented and illustrated on spectroscopic examples.