CEAS AND CRDS AT THz FREQUENCIES FOR TRACE LEVEL GAS ANALYSIS

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Cavity-Enhanced Absorption Spectroscopy (CEAS) and Cavity Ring-Down Spectroscopy (CRDS) are well established for sensitive infrared measurements of gas phase compounds at trace level using their rovibrational signatures [1,2]. Such resonant techniques may be employed at submillimeter [3] and millimeter wavelengths, and ultra-sensitive high-resolution THz spectrometers may be designed. Here we report about the successful development of two THz Fabry-Perot spectrometer, each based on a low-loss corrugated waveguide and highly reflective photonic mirrors, both achieving an effective path length of more than one kilometer and both able to work in CEAS or CRDS mode, the latest technique giving access to absolute quantification of the sample [4]. The first set-up operating in the frequency range 550-650 GHz is designed to probe the rotational transitions of light polar compounds at trace levels. A molecular absorption coefficient as low as $2.10^{-8}\ cm^{-1}$ is accessible to detection. Cavity length is controlled with a PID regulator locked on the maximum of a cavity mode. The second set-up operates between 150 and 215 GHz. It is designed to detect heavier molecules also at trace concentrations, such as semi-volatile organic vapors, explosive degradation products and taggants, which cannot be envisaged with a conventional detection technique [5,6]. Cavity length is controlled thanks to one moving mirror mounted on a stick-slip piezo linear stage in the nanometer resolution range. The minimum absorption coefficient reachable up to now is lower than $10^{-7}\ cm^{-1}$.

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p-number: p201 **Submitted on Thu, 15 Jun 2023 21:00:20 +0200**