

DIRECT FREQUENCY COMB SPECTROSCOPY FOR THE STUDY OF MOLECULAR DYNAMICS IN THE INFRARED FINGERPRINT REGION.^a

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The simultaneous identification of multiple chemical compounds requires spectroscopic techniques with inherently broad spectral bandwidth and high frequency resolution. This combination has been realized in the mid-infrared (MIR) molecular fingerprint region using direct frequency comb spectroscopy (DFCS) with an achieved spectral resolution on the order of 100 MHz over the entire comb bandwidth of several 100 cm^{-1} . When coupled to a high-finesse enhancement cavity or a multipass absorption cell, DFCS becomes an ultrasensitive tool for the detection of trace molecules in gas samples of biological, industrial, and atmospheric importance. Recently, the addition of a massively parallel detection scheme based on a MIR virtually imaged phased array (VIPA) disperser provides millisecond (ms) or better temporal resolution simultaneously over thousands of individual frequency channels making possible the study of transient chemical phenomena within the $2000\text{-}3500\text{ cm}^{-1}$ spectral window.

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