SENSITIVE INFRARED SPECTROSCOPY OF ISOPRENE AT THE PART PER BILLION LEVEL

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Isoprene (C_5H_8) is an important molecular target in trace gas sensing due to its presence in Earth's atmosphere and human breath. Isoprene is the most abundant of the so-called biogenic volatile organic compounds (BVOCs) emitted naturally into the atmosphere by plants, and so plays an important role in the chemistry of the troposphere. Isoprene is also one of the most abundant hydrocarbons present in human breath, and there is interest in measuring isoprene in breath as a way to perform noninvasive monitoring of patients. In both of these settings, isoprene is present as a trace gas at a concentration of parts per billion (ppb), making its detection quite challenging. We have used a quantum cascade laser-based infrared spectrometer to perform sensitive spectroscopy of isoprene down to the ppb level. We have used the strong Q-branch of the ν_{26} band of isoprene near 992 $\mathrm{cm}^{-1}$to monitor its concentration and achieved a minimum noise-equivalent concentration for our spectrometer of 3 ppb at an optimal averaging time of 25 s. We have also demonstrated the potential real-world applications of our approach by directly measuring the isoprene concentration in a breath sample from a volunteer.