DETECTION OF MEDICAL INHALER USE VIA TERAHERTZ SPECTROSCOPY

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HFA134a (aka 1,1,1,2 tetrafluoroethane) is the most common propellant in pressure metered dose medical inhalers (PMDIs). Rapid and easy detection of this compound can benefit various human health and performance sectors to identify an unintended medication and confirm adherence. Current medical screening is commonly performed by urinalysis which can be significantly influenced by the rate at which the target compound is processed into urine. As an alternative to urine, breath represents a readily available, easily obtained, and relevant biofluid for airway medication screening while detection of PMDI propellant serves as a more general marker of use. In this study, we demonstrate the novel use of THz spectroscopy, performed with a recently developed table-top THz chemical sensor, to detect and quantify HFA134a in breath as a marker of recent inhaler use at physiologically relevant concentrations. THz chemical analysis facilitates a near instantaneous (few minutes up to 30 minutes) post inhalation detection of propellant. These time scales are shorter than most urinalysis. The compact, and semiautomated nature of the sensor is amenable to rapid analysis on-site with minimal supporting material and components. In this study, we analyzed breath from 10 human subjects. Samples were obtained prior to and after a single dose of an albuterol inhaler. Analysis of the breath samples was performed by the table-top THz sensor and gas chromatography coupled to mass spectrometry (GC-MS) for validation. THz sensing demonstrated reliable detection of HFA134a in nearly all samples. The breath concentrations determined by the THz sensor and GC-MS exhibited exponential decay of breath-HFA134a with time constants varying between 2.5 to 6 minutes. The current sensitivity of the THz sensor allows to monitor HFA143a levels up to 30 minutes post inhalation.