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Detection of acetone in diabetes mellitus using gas-chromatography mass spectrometry and tungsten oxide based sensor

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Current diagnosis and monitoring of diabetes mellitus is typically achieved using "finger-prick" testing of blood glucose levels several times daily. Not only are these tests painful and costly over time, but also unsafe if proper handling is not undertaken. Breath analysis has attracted lots of interest in clinical and scientific research for its non-invasive diagnosis of various diseases. Human exhaled breath contains thousands of different volatile organic compounds (VOCs). Different VOCs can be used to diagnose certain diseases. Acetone has been used as a biomarker for diabetes mellitus. As a proposed alternative, several studies have been conducted on non-invasive breath acetone analysis as biomarker for monitoring diabetes, using Gas Chromatography Mass Spectrometry (GC-MS), Selected Ion Flow Tube-Mass Spectrometry (SIFT-MS), etc. Although these techniques are accurate, sensitive and specific, they are not suitable for routine diabetes management as the sample preparation and instrumentation required are expensive. An affordable, non-invasive, portable gas sensor (chemo-resistance) device made of Tungsten trioxide (WO3) is under development to monitor breath acetone levels. The preliminary tests has been conducted on 30 diabetic and 30 non-diabetic patients for measurement of breath acetone levels using Solid Phase Micro-extraction (SPME) –Gas Chromatography-Mass/Spectrometry (GC-MS) analytical technique. Results confirm the high amount of acetone (1.88 ppm) in diabetic patients and low amount of acetone (0.8 ppm) in non-diabetic patients. Furthermore, a good correlation between the established analytical technique for measuring breath acetone levels and the blood-glucose level "finger-prick" test r=95 were observed. Tungsten trioxide shows good characteristics of acetone sensor which is its monoclinic II (ε-WO3) phase.

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