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Point-of-Care Diabetes Monitoring via Breath Acetone Detection

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Et al.

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Purpose

Diabetes can be a life-long disease which requires continuous blood-glucose monitoring. Currently technology, albeit good, does have its draw-backs; in particular that it is an invasive technique which causes discomfort to the individual. Therefore, low compliance can ultimately lead to other health issues. Approaches are underway to develop a portable, hand-held, noninvasive monitoring device to detect the biomarker, acetone, found in the breath of diabetics. By creating films of poly(4-vinylbenzeneboronic acid) and poly(allylamine hydrochloride), acetone can react with these via a Petasis reaction. This alters the physicochemical nature of the film, providing a quantification of acetone, and thus hopefully blood-glucose levels, in a non-invasive manner.

Methods

UV-transmitting poly(methyl methacrylate) slides are coated with a system of PAH/PVBBA at differing pH values and are then exposed to acetone/water vapor. Concentrations of acetone evaluated are 0.1–10 ppm. The slides are next subjected to the light emitted by a diode with a peak wavelength of 300 ± 5 nm. The transmitted light is detected by a UV-photosensor with an integrated transimpedance amplifier that produces a voltage output as a function of absorption.

Results

We have successfully synthesized poly(4-vinylbenzeneboronic acid) and multilayered with poly(allylamine hydrochloride). We have been able to cross-link these two polymers using only acetone vapor and are developing a hand-held device. Analyzing the difference in output voltage from exposed to unexposed slides at varying acetone concentrations, provides is a linear relationship up to 2500 ppb, which is above the high point for breath acetone concentration.

Conclusions

We have been able to develop a technology that accurately detects acetone vapor. We are engineering a hand-held breathalyzer device to detect acetone in the breath of diabetic individuals and are attempting to optimize its capabilities.