A Wireless Paired Emitter Detector Diode Device as an Optical Sensor for Lab-on-a-Disc Applications

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Introduction

Over the last decade increased awareness of long term consequences of water contamination has taken the spotlight of the chemical sensing community, as water quality monitoring plays a crucial role in understanding and managing potential risks. This spurred the need of development of inexpensive optical sensors capable of wireless communication1. This report describes the first use of a wireless paired emitter detector diode device (PEDD) as an optical sensor for colorimetric analysis for Lab-on-a-Disc applications. The method achieves excellent sensitivity and signal-to-noise ratio (SNR) in comparison to the more commonly employed method of coupling a light emitting diode (LED) to a photodiode. The low cost, small size, low power consumption, increasing spectral range coverage (247–1550 nm), intensity and efficiency, ease of fabrication and simplicity of the PEDD make it an ideal optical detector for colorimetric assays2. In terms of microfluidics, the non-contact PEDD detection scheme aligns perfectly with centrifugal Lab-on-a-disc systems, which typically have difficulties in monitoring during rotation3.

Prototype

The instrument consists of two Surface Mount (SMT) LEDs, placed above and below the sensing area of a disc, with supporting electronics (Fig. 1). One LED acts as the light source while the other is reverse biased, acting as a detector.

Calibration of the system

Preliminary characterization of the device showed the light intensity from three different colour dyes placed in sequential disc reservoirs (Fig. 2).

Results

A series of dilutions for both analytes were examined with the PEDD system in the disc reservoirs.

Conclusions

A portable system for long-term colorimetric analysis in solution has been developed. This device incorporates low power detection coupled with wireless communication and power supply into Lab-on-a-disc system. Integration of a wireless communication device allows data acquisition according to individual needs. Similar limits of detection between PEDD system and standard UV–Vis spectrometer, 2.5x10^(-6) to 5x10^(-5) M, imply that the system is highly sensitive thus allowing for detection even low concentrations levels. In general, this shows potential for the PEDD system to be a cheap and versatile alternative optical detector for lab-on-a-disc applications.

Further work on the system would include better packaging in order to improve the detection limit by reducing external light noise and more extensive experimentation with various analytes in point-of-care settings.

References


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