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Novel optical sensing system based on wireless paired emitter detector diode device for lab on a disc water quality analysis

Increased demand for improved water management is a driving need for water quality monitoring systems with greatly improved price/performance characteristics. Typical analysis methods are very costly and time consuming, therefore simple, rapid, accurate, cost-effective field-deployable sensors incorporating wireless communication capabilities need to be developed [1]. The main requirements of these sensors such as reproducibility, low cost as well as selectivity and sensitivity must be met for scale-up and mass fabrication allowing for real-time monitoring as well as widespread field deployment.

The first use of a wireless paired emitter detector diode (PEDD) as an optical sensor for water quality monitoring in a lab-on-a-disc device will be presented. The microfluidic platform is based on a pH dye/ionogel sensing area, combined with a low-cost, wireless optical sensor, PEDD, for monitoring the pH and the degree of turbidity of water samples in real time. So far, environmental water quality analysis has been provided by standard lab-on-a-chip systems [2], but not by centrifugal disc (CDs) platforms, which offer many advantages such as the elimination of large power supplies and external pumps.[3]

The PEDD device involves two light emitting diodes (LEDs), placed above and below the sensing area. The resulting system is portable, incorporates wireless communication and is completely sustained via a small lithium polymer battery, Figure 1a. The sensing function is provided by a pH indicator dye, which is immobilized within an ionogel polymer matrix, Figure 1b.

We believe that this device will be of special interest in samples with a relatively high level of solid contaminants that could interfere with optical analytical measurements.

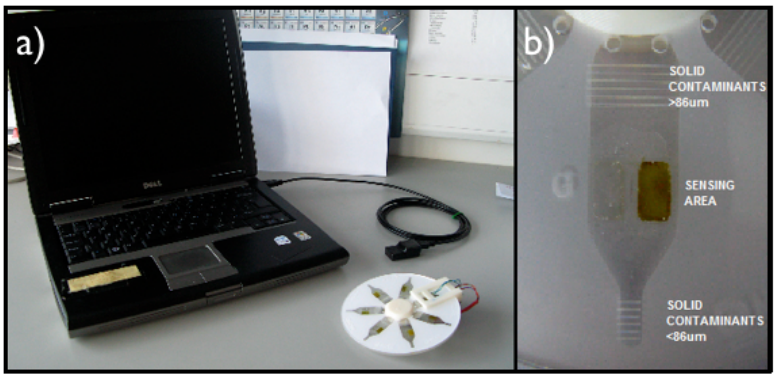

Figure 1: a) Prototype of the PEDD centrifugal micro-fluidic system, b) channel consisting of three chambers.

References:

1. "Determination of Phosphate using a Highly Sensitive Paired Emitter-Detector Diode Photometric Detector", M. O'Toole, K. T. Lau, R. Shepherd, C. Slater, D. Diamond, *Analytica Chimica Acta,* 597, 290 (2007).
2. "State-of-the-art lab chip sensors for environmental water monitoring", A. Jang, Z. Zou, K. Lee, C. H. Ahn, P. L Bishop*, Meas. Sci. Technol*., 22, 032001 (2011).
3. "Validation of a centrifugal microfluidic sample lysis and homogenization platform for nucleic acid extraction with clinical samples", J. Siegrist, R. Gorkin, M. Bastien, G. Stewart, R. Peytavi, H. Kido, *Lab Chip*, 10, 363 (2010).

Brief Bio: Monika Czugala graduated from West Pomeranian University of Technology in Szczecin, Poland, in 2010. She was awarded with the Master of Science degree in Materials Engineering from the Faculty of Mechanical Engineering and Mechatronics. During her university studies she took part in innovate and successful project "Polish Artificial Heart" in which she was responsible for mechanical testing of novel polymeric biomaterial for fully implantable prosthesis. In October 2010 she joined the research group of Prof. Dermot Diamond as a postgraduate student in the Marie Curie Initial Training Network ATWARM Research program to carry out research on the "Generation of fully functioning biomimetic analytical platforms for water quality based on microfluidic technology". Her research focuses on the characterization of novel chemo- and biosensors based on functional materials and their integration in analytical platforms based on microfluidic technology for environmental application. (http://www.dcu.ie/chemistry/asg/new/)