A 3D-printed automated sample storage unit for sporadic sampling in inaccessible aquatic environment

A Errachid[1], J Gallardo González[1], K Pachowicz[2], A Baraket[1], A Trynda[3], M Hangouet[1], N Zine[1], D Bouraya[5], R Anastase[5], J Bausells[4] and **F Solano[2]**

[1]UMR 5280-Institut des Sciences Analytiques, CNRS, Université de Lyon, France
[2]Warsaw University of Technology, Poland
[3]Central Laboratory of Forensic Police, Poland
[4]Barcelona Microelectronics Institute IMB-CNM (CSIC), Spain
[5]BioTray-Microtechnology for Life Science & Chemistry Application, France

Sewage epidemiology has been proven to be a powerful tool to profile a community's behaviour both in large and small areas. Conventional wastewater analysis is based on manually taken samples, subsequent transport to a specialized lab environment and analysis within a certain period of time. However, due to the high logistic efforts, sampling intervals are usually rather long and can hardly be carried out spontaneously or out of a well-planned sampling campaign. Therefore, automated sampling devices are becoming popular nowadays, as they can be placed on-site in a single operation and be in stand-by mode during long periods of times waiting to be triggered by a predefined sampling protocol. In this context, we report on a miniaturized, low-cost, easy-to-operate and low-power consumption microfluidic automated sampler for sporadic sample collection. The device uses a piezoelectric micropump and three miniaturized electro-valves that are assembled in a 3D-printed microfluidic manifold. Up to three samples can be stored in a 3D-printed single manifold that contains three 2.3 mL reservoirs connected to main body of the device. Moreover, the automated sampler can be remote controlled using a customized control board that enables to trigger the system and set a desired flow rate and time of sampling. Furthermore, its low-power- consumption feature enables the device to be powered through a lithium battery. All these qualities make the automated sample device to be very useful for applications where one or several sporadic samples must be taken in poor accessible environments such as the sewer network without the need of personal presence during the sampling event.

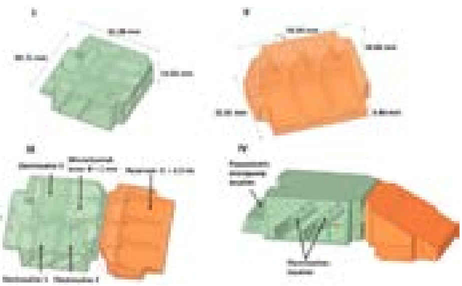

Figure 1: CAD 3D of the microfluidic manifold

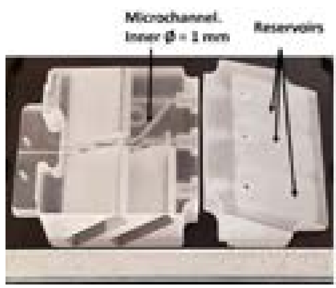

Figure 2: Image of transparent manifolds manufactured using the Projet MJP 3600 Max 3D printer (stereolithography).

Recent Publications:

1. Baraket A, Lee M, Zine N, Yaakoubi N, Bausells J and Errachid A (2016) A flexible electrochemical micro lab-on-chip : application to the detection of interleukin-10. Microchim. Acta 183:2155–2162.

2. Baraket A, Zine N, Lee M, Bausells J, Jaffrezic Renault N, Bessueille F, Yaakoubi N and Errachid A (2013) Development of a flexible microfluidic system based on a simple and reproducible sealing process between polymers and poly (dimethylsiloxane). Microelectron Eng. 111:332–338.
3. Gallardo Gonzalez J, Baraket A, Boudjaoui S, Metzner T, Hauser F, Rößler T, Krause S, Zine N, Streklas A, Alcácer A, Bausells J and Errachid A (2019) A fully integrated passive microfluidic Lab-on-a-Chip for real-time electrochemical detection of ammonium: Sewage applications. Sci. Total Environ. 653:1223–1230.
4. Lee M, Lopez Martinez M J, Baraket A, Zine N, Esteve J, Plaza J A, Jaffrezic Renault N and Errachid A (2013) Polymer micromixers bonded to thermoplastic films combining soft- lithography with plasma and aptes treatment processes. J. Polym. Sci. Part A Polym. Chem. 51:59–70.
5. Mills C A, Fernandez J G, Martinez E, Funes M, Engel E, Errachid A, Planell J and Samitier J (2007) Directional alignment of MG63 cells on polymer surfaces containing point microstructures. Small 3:871–879

Biography

A Errachid is a Full Professor Classe Exceptionnelle at the University Claude Bernard-Lyon 1 since the end of 2008. He received his PhD degree from the Universitat Autonoma de Barcelona in 1997. Between 1997 and 2001 he worked as Junior Research Scientist at the Centro National de microelectronica (CNM). He later joined the Department of Electronics of University of Barcelona and IBEC as Senior Research, where he worked from 2001 till 2008. He has obtained top-level results in the field of silicon-based (bio)chemical sensors using field-effect transistors and micro/nanoelectrode structures. His deep knowledge and understanding of the electronic devices structure as well as operation and interplay between (bio)chemical molecules and electronics, has resulted in development of novel (bio)sensor devices such as, the original nanosensor device based on olfactory proteins developed under SPOT-NOSED project, amongst others). He has an extensive expertise in EU projects coordination and participation, including KardiaTool (H2020-NMBP-X-KET-2017 no. 768686), HEARTEN (H2020-PHC-26-2014, no. 643694), MicroMole (H2020-FCT-2014, no. 653626), DiagCan (FP7-PEOPLE-2013-IEF, no. 628363), Sea-on-a-Chip (FP7-OCEAN-2013, no. 614168), SMARTCANCERSENS (ICT FP7, no. 294993), and SensorART (ICT-FP7, no, 248763) projects. To date, he has published more over than 195-refereed Scopus papers and his h-index is 28.

abdelhamid.errachid-el-salhi@univ-lyon1.fr

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