Lab-on-a-disc platform with an integrated potentiostat for real-time drug release monitoring

Thoppe Rajendran, Sriram; Bergkamp, Max H.; Scarano, Ermes; Nielsen, Line Hagner; Hwu, En Te; Zor, Kinga; Boisen, Anja

Publication date: 2018

Document Version
Publisher's PDF, also known as Version of record

Link back to DTU Orbit

Citation (APA):
Lab-on-a-disc platform with an integrated potentiostat for real-time drug release monitoring

Sriram Thoppe Rajendran1, Max H. Bergkamp1,2, Ermes Scarano1,2, Line Hagner Nielsen1, En-Te Hwu1, Kinga Zór1 and Anja Boisen1

1 The Danish National Research Foundation and Villum Foundation’s Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics (IDUN), Department of Micro- and Nanotechnology, Technical University of Denmark, Kgs. Lyngby, 2800, Denmark
2 Department of Biomedical Engineering, Eindhoven University of Technology, Eindhoven, 5600, The Netherlands
3 Department of Electrical Engineering and Information Technology, University of Naples Federico II, Naples, 80125, Italy
stran@nanotech.dtu.dk

Keywords: Lab-on-a-disc, electrochemical sensor, wireless potentiostat, real-time drug release monitoring

Drug release monitoring is commonly performed using instrumentation where large sample volumes are required for evaluation of a release profile [1]. However, in the initial stage of development and optimization, a device enabling measurement in low sample volumes, could be beneficial to accelerate the screening process of drug delivery systems.

Lab-on-a-disc (LoD) platforms have gained significant interest in both academic research and industry [2], since these systems require minimal instrumentation i.e. spinning motor for liquid transport and handling, consequently enabling the realization of simple, compact and integrated detection systems requiring low sample volumes for analysis. Additionally, the integration of electrochemical detection with microfluidics has several advantages [3], since both the electrodes and the instrumentation can be miniaturized, multiplexed and automated without losing performance [3,4].

We developed a LoD system with electrochemical sensors, electrodes, fabricated on a plastic support, placed in the detection chamber (Fig. 1a) and optimized the fluidic design to achieve controllable flow rates (Fig. 1b). The fluidic system was integrated with a custom build potentiostat (Fig. 1c), which was connected wirelessly to a smartphone and controlled via an app. Due to the wireless communication, there is no need for cables to connect the electrodes to the detector (potentiostat) and measurements can be carried out during spinning, in the flow. Consequently, drug release monitoring can be carried out in real-time electrochemically. The flow rate was measured optically (Fig. 1b), and the performance of the electrodes was evaluated in the flow. As it is shown in (Fig. 1d), the amperometric response changes corresponding to the spinning frequency of the disc.

As a case study, we evaluated the release profile of an electrochemically active model compound ferricyanide (Fic) from microcontainers. As it can be seen in (Fig. 1e), the released Fic from the microcontainers can be measured in real-time. The developed analysis unit will be used for the investigation of release profile when working with different pH-sensitive polymer coatings used for various microcontainer designs.

References:


