VIDEO ARTICLE

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Multiplexed Biosensors for Point-of-Care Management of Infectious Diseases

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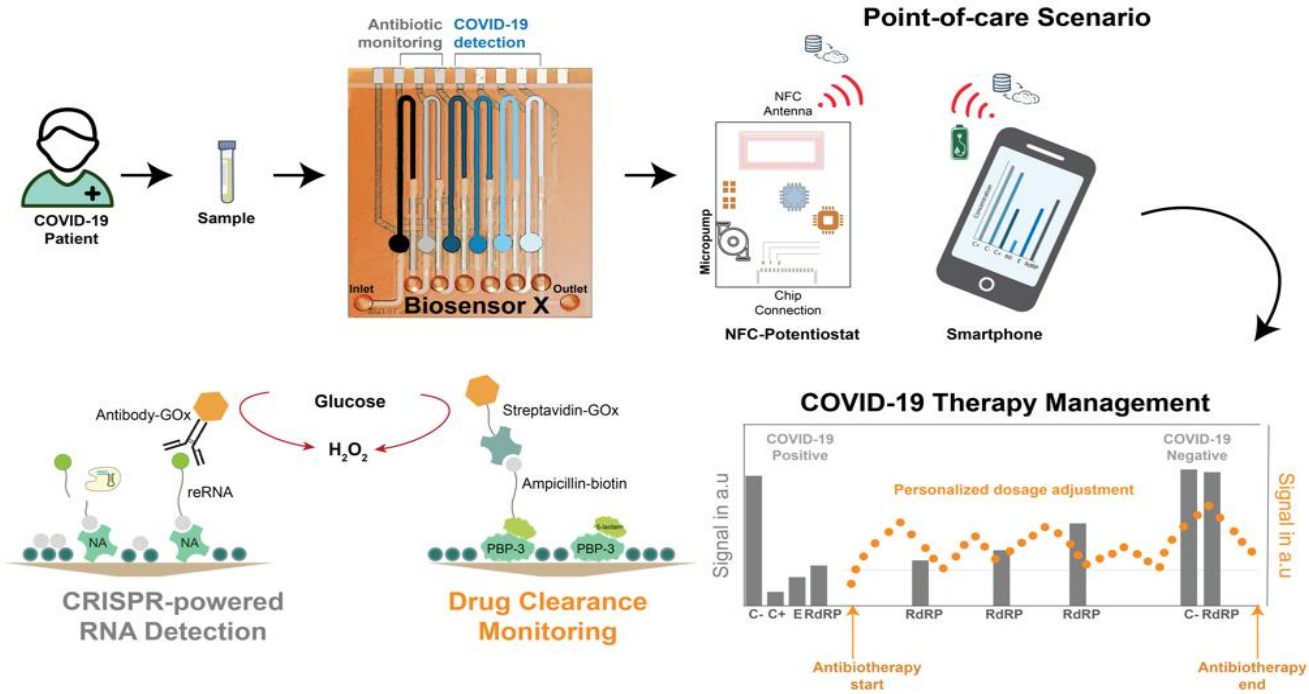
Graphical Abstract

Point-of-care scenario of COVID-19 diagnosis and therapy monitoring using the proposed multiplexed microfluidic biosensor (BiosensorX)[5].



Abstract

Nucleic acid testing is vital for the diagnostics and treatment monitoring of different diseases in medicine. It primarily involves with the measurement of mutations in DNA sequences, pathogen-specific oligonucleotides or changes in gene expression levels [**1**]. Over the recent years, especially the (re)emergence outbreak of infectious diseases (such as COVID-19 disease caused by SARS-CoV-2 infections) and finding of nucleic acid-

based biomarkers (such as microRNAs) further stimulate the development of novel tools for nucleic acid diagnostics. Herein, CRISPR/Cas technology, broadly applied in gene editing, features a powerful method for the highly sensitive and selective detection of nucleic acids [**2**]. In this talk, first a short overview of CRISPR-powered biosensing will be given where two different detection modes, binding- and cleavage-based sensing, will be discussed[2]. Subsequently, an electrochemical microfluidic multiplexed biosensor (BiosensorX) platform for point-of-care management of COVID-19 will be introduced (see **Graphical Abstract**) [**3,4,5**]. The technology developed is capable of gauging 4, 6, or 8 (different) analytes or specimen simultaneously via a sequential chip design, including multiple immobilization areas, where the assay reagents are simply adsorbed, followed by their individual electrochemical measurement cells, where the signal readout takes place by means of amperometry, within a single microfluidic channel. In this study, different (RdRp and E) genes of SARS-CoV-2 (Omicron-variant) in clinical samples is simultaneously screened and identified by employing the enzyme LbuCas13a. By eliminating the need for a reverse transcription and nucleic acid amplification of the viral RNAs (which is necessary for PCR and other detection methods), an LOD of 2,000 copies per µl (4.06 fM) for the E gene and 7,520 copies per µl (15.04 fM) for RdRP is achieved within a sample-to-result time of about 30 minutes. Moreover, in order to demonstrate the feasibility of combining assays based on different classes of biomolecules (here, nucleic acids along with drugs), antibody-free ß-lactam antibiotic detection using a penicillin-binding protein-based bioassay is performed on the same biosensor device. Without the need for any target amplification, BiosensorX platform offers an affordable, easily scalable and multiplexed approach for point-of-care testing of nucleic acids via CRISPR-based bioassays and other biomolecule classes (such as drugs) at the same time.

Keywords: CRISPR diagnostics; COVID-19; antibiotics; multiplexed microfluidics; electrochemical biosensors.

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Biography of Presenting Author

Can Dincer is currently junior research group leader at FIT Freiburg Center for Interactive Materials and Bioinspired Technologies and at the Department of Microsystems Engineering (IMTEK) of the University of Freiburg. The main research interest of his group "Disposable Microsystems" is the development of bioanalytical materials/sensors/ microsystems and their combination with data science and artificial intelligence for various applications including point-of-care diagnostics, wearables, food and environmental analysis. Having completed his studies in microsystems engineering, Dr. Dincer received in 2016 his Ph.D. degree with summa cum laude from the University of Freiburg. Between June 2017 - June 2019, he also worked as a visiting researcher at the Department of Bioengineering at the Imperial College London. Since

September 2019, he is also an Associate Editor of the journal "Biosensors and Bioelectronics" (Elsevier). In June 2022, he has joined to the International Advisory Board of the new journal "Advanced Sensor Research" (Wiley).

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