Electrochemical miniaturized (bio)sensors to support the sustainable management of COVID-19 outbreak

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The huge issue of novel SARS-CoV-2 coronavirus is the high infectivity allowing for hard management of this outbreak, thus a rapid and on-site analysis is a need to contain the spread of COVID-19. Herein, I present the results achieved in collaboration with the Scientific Department, Army Medical Center, Italian Ministry of Defense, GTS Consulting, and SENSE4MED companies for the development of a screen-printed electrode-based immunosensor for SARS-CoV-2 detection in saliva. The electrochemical assay was conceived for Spike (S) protein or Nucleocapsid (N) protein quantification using magnetic beads as support of the immunological chain. The analytical features of the electrochemical immunoassay, using screen-printed electrode modified with nanomaterial carbon black as a platform, were evaluated in untreated saliva with a detection limit equal to 19 ng/mL and 8 ng/mL, respectively for S and N protein. The suitability of this device was assessed using the cultured virus in biosafety level 3 and saliva clinical samples, comparing the data with Real-Time PCR of nasopharyngeal swab specimens, demonstrating the capability to detect SARS-CoV-2 in saliva at a low CT number [1]. Disinfection processes cover another key point in the COVID-19 outbreak. We designed an electrochemical paper-based device for the assessment of hydrogen peroxide nebulized by a cost-effective ultrasonic aroma reconverted diffuser. The paper-based sensor was fabricated by modifying via drop-casting a filter paper-based screen-printed electrode with a dispersion of carbon black-Prussian Blue nanocomposite, for the detection of hydrogen peroxide at -50 mV vs Ag/AgCl. The use of a paper-based modified screen-printed electrode loaded with phosphate buffer allowed for monitoring the concentration of hydrogen peroxide in aerosol without any additional sampling instrument to capture the nebulized solution of hydrogen peroxide at a concentration up to 7% v/v [2]. Hydrogen peroxide, a reconverted ultrasonic aroma diffuser, and a paper-based electrochemical sensor assisted by smartphone have demonstrated how different low-cost technologies are able to supply useful and cost-effective solutions for disinfection procedures.

REFERENCES

[1] Fabiani, L., Saroglia, M., Galatà, G., De Santis, R., Fillo, S., Luca, V., Faggioni, G., D'Amore, N., Regalbuto, E., Salvatori, P., Terova, G., Moscone, D., Lista, F., Arduini, F Biosensors and Bioelectronics 171 (2021) 112686, Filled patent 102020000016948, 2020, Italian Ministry of Economic Development
[2] F. Arduini, L. Fiore, V. Mazzaracchio, Filled patent 102021000000257, 2021, Italian Ministry of Economic Development.

FIGURE

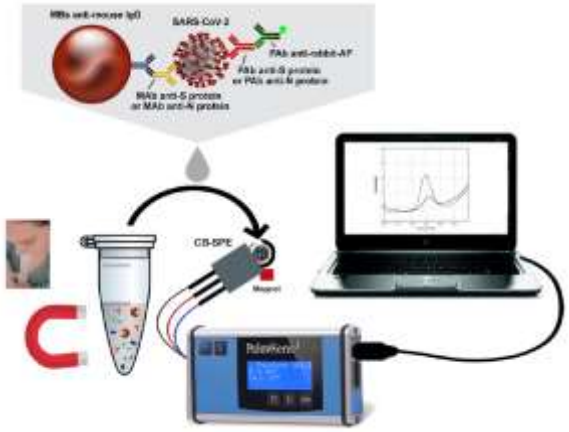

Figure 1: Scheme of immunosensor based on magnetic beads and screen-printed electrode modified with carbon black for SARS-CoV-2 detection in saliva