Origami paper-based biosensor to SARS CoV-2 on the surface

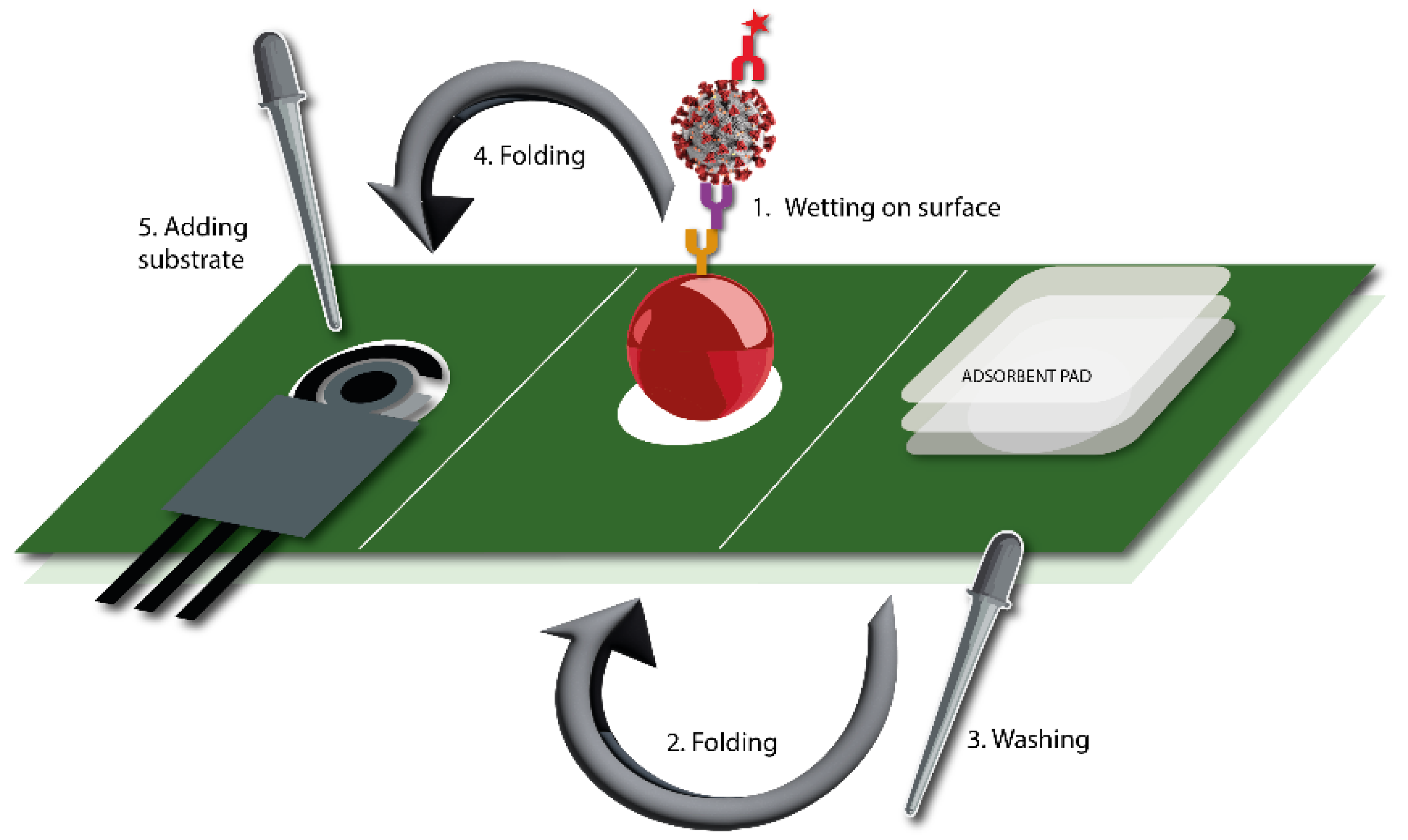
Laura Fabiani[a], Rachele Petrocchini[a], Giorgia Grilli[b], Riccardo De Santis[b], Florigio Lista[b], Fabiana Arduini[a]

[a] Department of Chemical Science and Tecnologies, University of Rome Tor Vergata, via della ricerca scientifica 1, Rome, Italy

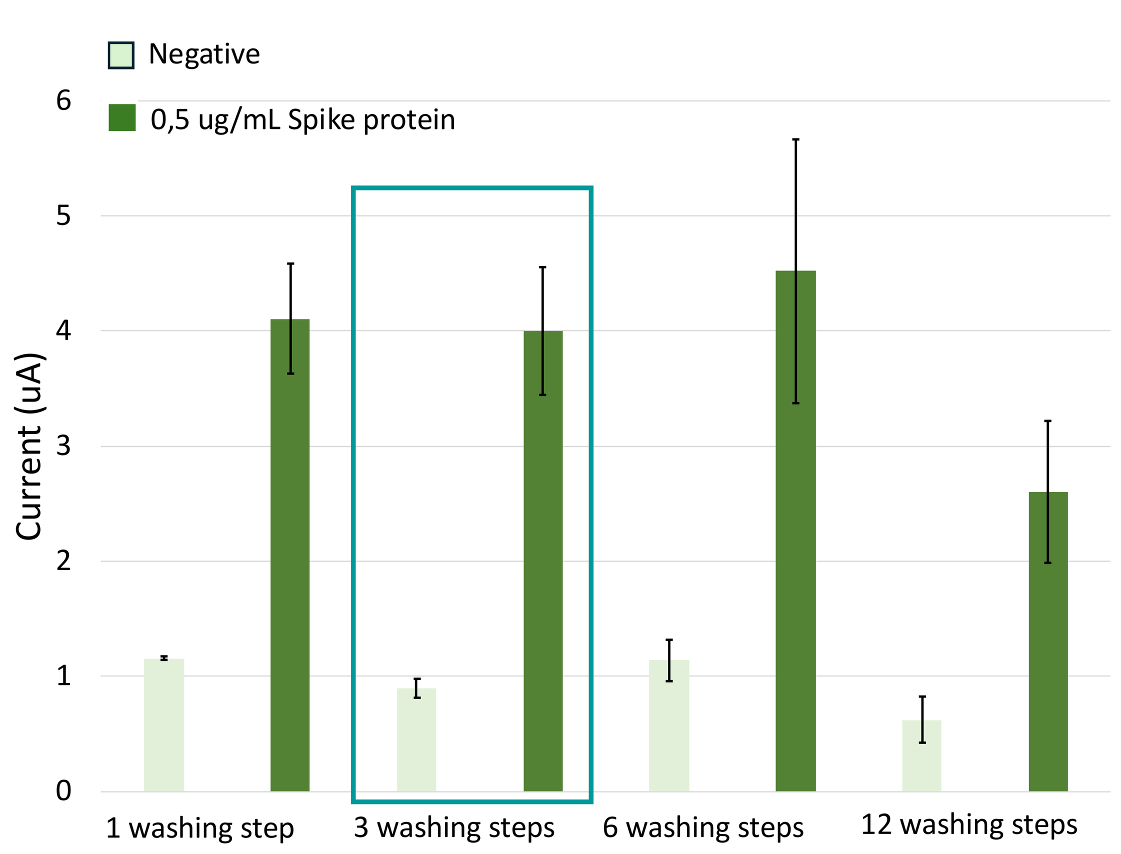
[b] Defence Institute for Biomedical Sciences, Via Santo Stefano Rotondo 4, 00184 Rome, Italy

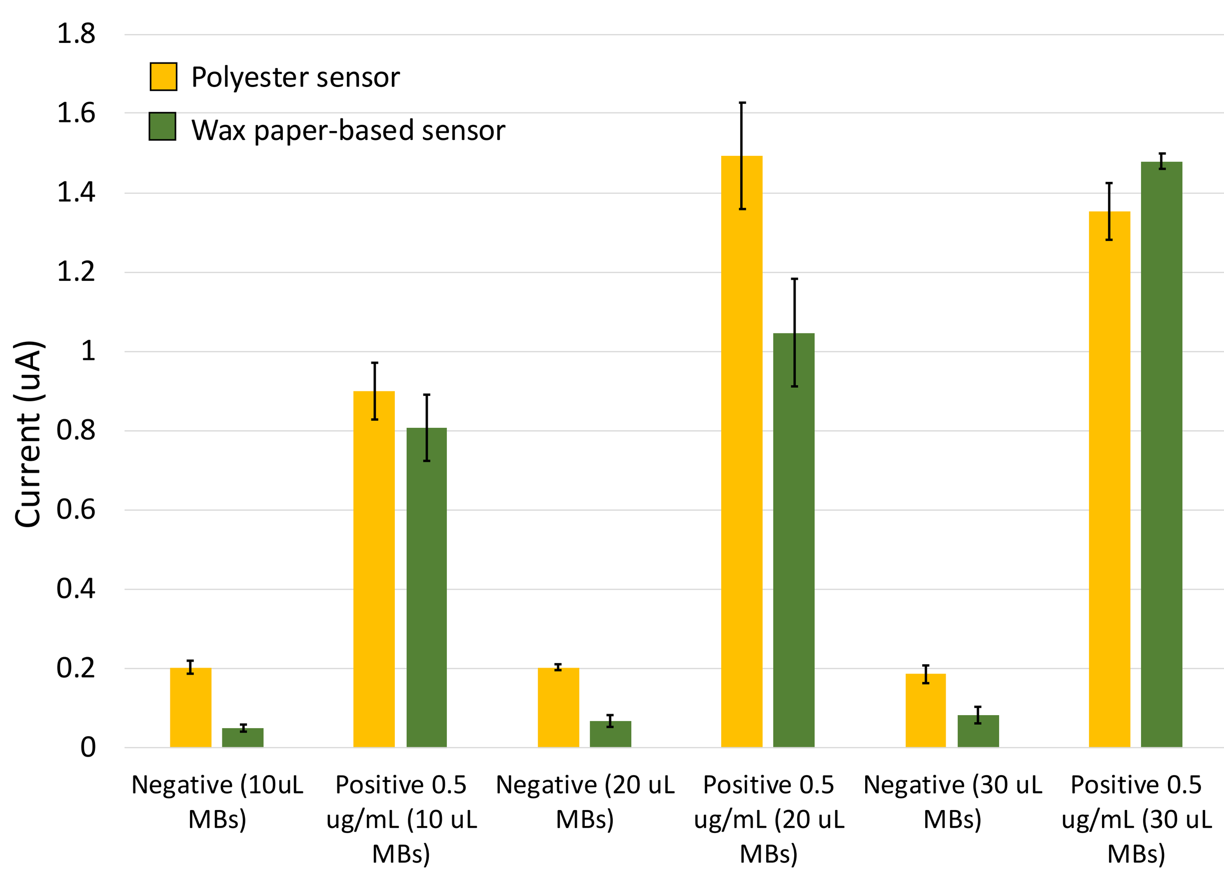
CONCEPT

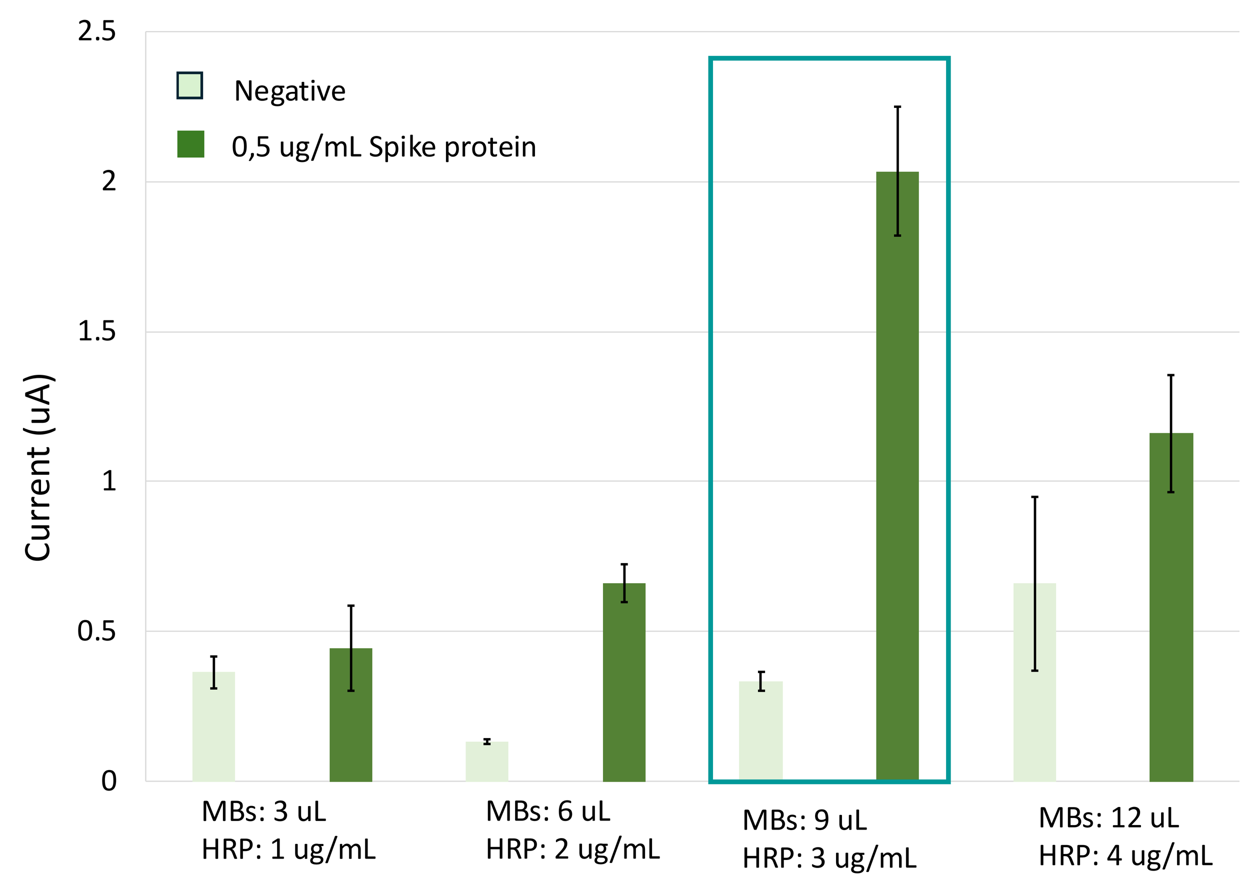
The European project RELIANCE aims to create modified self-disinfecting surfaces as a way to control the spread of pathogens better. In this context, we present a paper origami electrochemical sensor that we are developing, which can measure the effectiveness of the specific surface modification. Following up on our previously published work [1], which was the first publication describing an electrochemical immunosensor for SARS-CoV-2 detection in saliva, we adapted the sensor to easily detect the virus on the surface. The method uses the magnetic beads as support for the sandwich-type immunological chain, which, thanks to their high surface/volume ratio, permits the load of a high amount of antibodies, improving the assay sensitivity. Currently, our work is refining the design of the sensor origami model by selecting the type of paper to use.



Optimization of MBs-based assay



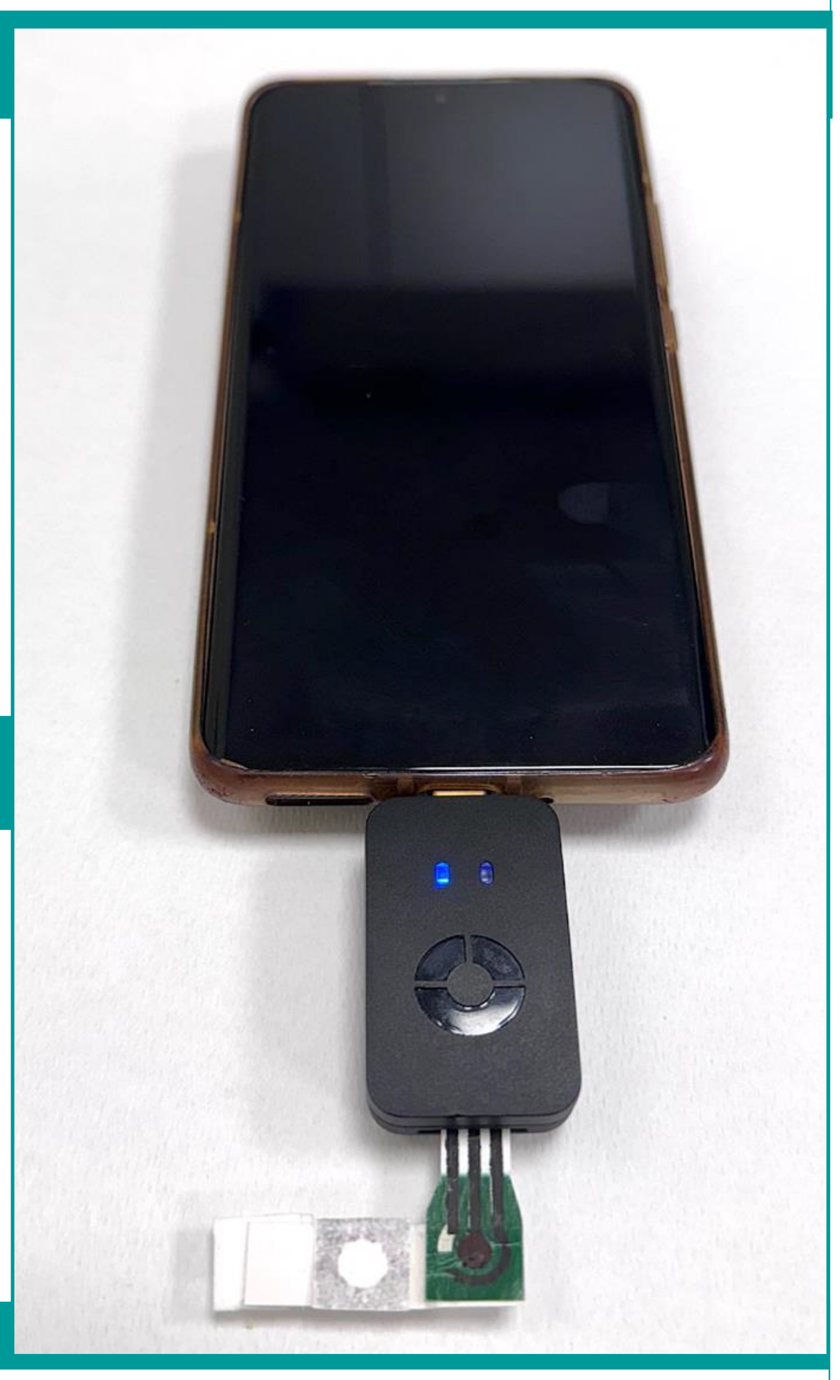




We have optimized the number of washing steps, the MBs volume (30 µL in tube, 9 µL on electrode), the working volume (150 µL in tube, 45 µL on electrode), and the labeled antibody concentration (1 µg/mL in tube, 3 µg/mL on electrode) using a Spike protein concentration of 0,5 µg/mL. The objective is to pre-load the specific recognition elements to wax paper wells to enable easier measurement.

Future developments

- Implementation of origami configuration
- Optimization of reagent pre-loading
- Testing of the immunosensor analytical performances
- Specificity testing
- Surface testing of real samples



Conclusions

We are implementing a series of strategic developments aimed at enhancing system efficiency, reliability, and analytical performance. These improvements will play a crucial role in optimizing our methodologies and expanding the potential applications of our technology. This approach allows for a very easy workflow: the wax paper well is placed on the surface to be tested, a washing step is performed, then the well is folded onto the electrode for detection, and the substrate is added. In this way, our sensor addresses wider goals by providing a simple method to measure SARS-CoV-2 on different surfaces.

Reference

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. (2021). Magnetic beads combined with carbon black-based screen-printed electrodes for COVID-19: A reliable and miniaturized electrochemical immunosensor for SARS-CoV-2 detection in saliva. Biosensors and Bioelectronics, 171, 112686. 10.1016/j.bios.2020.112686

Acknowledgements

The RELIANCE consortium consists of 15 partners spanning 8 EU and 2 non-countries. Partners include research institutions, universities, SMEs, and large industries.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Health and Digital Executive Agency (HADEA). Neither the European Union nor the granting authority can be held responsible for them.

This project has received funding from the European Union's Horizon Europe research and innovation program, grant agreement No 101058570 (RELIANCE).