Quantifying personal protection against Covid-19 infection

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Starting from the first Italian lockdown in Spring 2020, our research group focused on potential strategies and electronic biosensors that could tackle the spreading pandemic and support the burdened national healthcare services. We developed an electronic platform able to quantify the presence of Sars-Cov-2 virus-neutralizing active antibodies in a patient, to effectively assess his/her actual protection from the virus. We had recently demonstrated the ability of our planar Organic Electrochemical Transistors (OECTs) to provide a real-time monitoring of in-vitro cell tissue formation, detachment, and disruption, induced by external toxic agents. Our OECTs are based on a ion-to-electron conducting polymer PEDOT:PSS (poly(3,4-ethylenedioxythiophene):poly(styrene sulfonate)) able to convert the ions in the electrolyte into an electrical signal. Any impediment positioned between the channel and the gate of the device will hinder the ion flux into the polymer layer, slowing down the transistor response to a gate potential switching. Accordingly, OECTs could supply an electrical, real-time output reporting cell layer integrity and health. We translated our know-how into an electronic platform able to be operated remotely as a multiple neutralizing assay, a powerful tool used to assess the neutralizing power of antibodies in human serum via monitoring a cell tissue response after exposure to a virus, incubated with progressive dilution of the patient serum.

A recent work published in on Nature Communications Materials reports how our system, integrating multiple OECTs as a multiwell plate, proved to be able to discriminate, in real time, between Sars-Cov-2 viral proliferating cultures and viral-neutralized ones, dramatically shortening the time of standard neutralization assays, reducing the risk for the operator, avoiding the use of toxic compounds and allowing an automated remote evaluation inside the incubator. The devices are low-cost, low power-consuming and industrially scalable, thus offering an effective means to speed up the viral neutralization screening of Covid-19 on larger scales with higher automated reproducibility, monitoring a population immunity after direct contact with the virus or vaccination.

Quantifying the presence of neutralizing antibodies and monitoring its evolution in time for each patient provides a much needed, better understanding of the actual personal protection and guiding vaccination towards more vulnerable population. Owing to the aspecific nature of the serum neutralization screening, our OECT electronic platforms are extremely versatile and can be employed with different cell lines and viruses: they can easily be employed for the study of other cytopathic viruses and cell lines, for extensive, real-time monitoring and operator-safe evaluations over several critical viral infections relevant for humans and animals.

Beatrice Fraboni – Full Professor in Physics at the University of Bologna, coordinates the "Semiconductor Physics" research group. Her research activity, of an experimental nature, concerns organic and hybrid semiconductor materials for innovative electronic devices, for applications such as biosensors and direct ionizing radiation detectors.