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PEDOT:PSS OECTs as versatile devices for monitoring cytotoxicity and viral infection in real-time

F. Decataldo,[1] **L. Grumiro,**[2] **M. M. Marino,**[2] **F. Faccin,**[3] **C. Giovannini,**[4,5] **M. Brandolini,**[2] **G. Dirani,**[2] **F. Taddei,**[2] **D. Lelli,**[3] **M. Tessarolo,**[1] **M. Calienni,**[1] **M. Barbalinardo,**[6] **D. Gentili,**[6] **F. Valle,**[6] **M. Cavallini,**[6] **C. Cacciotto,**[4] **A. Lavazza,**[3] **V. Cattani,**[7] **B. Fraboni,**[1*] **A. Scagliarini**[4*] **and V. Sambri**[2,4] **B. Fraboni,**[1]
[1] *Department of Physics and Astronomy, Alma Mater Studiorum - University of Bologna, Viale Berti Pichat 6/2, 40127 Bologna (Italy)*
[2] *Unit of Microbiology, The Great Romagna Hub Laboratory, 47522 Pievesestina, Italy*
[3] *Istituto Zooprofilattico Sperimentale della Lombardia e dell'Emilia Romagna "Bruno Ubertini" (IZSLER), 25124 Brescia, Italy*
[4] *Department of Experimental, Diagnostic and Specialty Medicine- DIMES, Universtity of Bologna, 40138 Bologna, Italy*
[5] *Center for Applied Biomedical Research (CRBA), S.Orsola-Malpighi University Hospital, 40138 Bologna, Italy*
[6] *Istituto per lo Studio dei Materiali Nanostrutturati, Consiglio Nazionale delle Ricerche, (ISMN-CNR), Via P. Gobetti 101, 40129 Bologna, Italy*
[7] *DVM, Department of Veterinary Medical Sciences, University of Bologna*
francesco.decataldo2@unibo.it

Semiconducting polymers are very promising materials for biomedical applications because of their ability to conduct both ions and electrons, their biocompatibility and their flexible and soft mechanical properties. In particular, poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT:PSS) has high conductivity, electrochemical and thermal stability in aqueous environment and reversible electrochemical properties that make it suitable as smart biointerface with biological elements and environment.[1], [2]

In our work, we present PEDOT:PSS-based Organic Electrochemical Transistors (OECTs) for the electrical continuous monitoring of cell viability[3], providing an easy, fast and real-time output which overcomes standard optical evaluation techniques and do no need toxic substance staining or highly-specialized operators. Cells are directly grown on transparent, PEDOT:PSS-based thin film OECTs: the presence of a cell monolayer slows down ion flux from the electrolyte into the semiconducting polymer, thus allowing for an electronic readout of cell layer integrity and health. We demonstrated that the devices can thus be employed for evaluating cytotoxicity of external agents,[4] viral infection pathway and viral titration. Moreover, testing Sars-Cov-2 infected cells, we observed that OECTs can automatically perform serum neutralization assays in less than 48h (earlier than the usual 72-hour required for actual standard screening), quantifying the neutralizing antibodies present in human sera.[5]

This work shows that PEDOT:PSS OECTs provide a scalable, low-cost and versatile biosensor able to monitor several cell cultures and their stress/cytopathic response, paving the way for high throughput and low-cost drug discovery screening, toxicology evaluations, viral titration or serum neutralization assays.

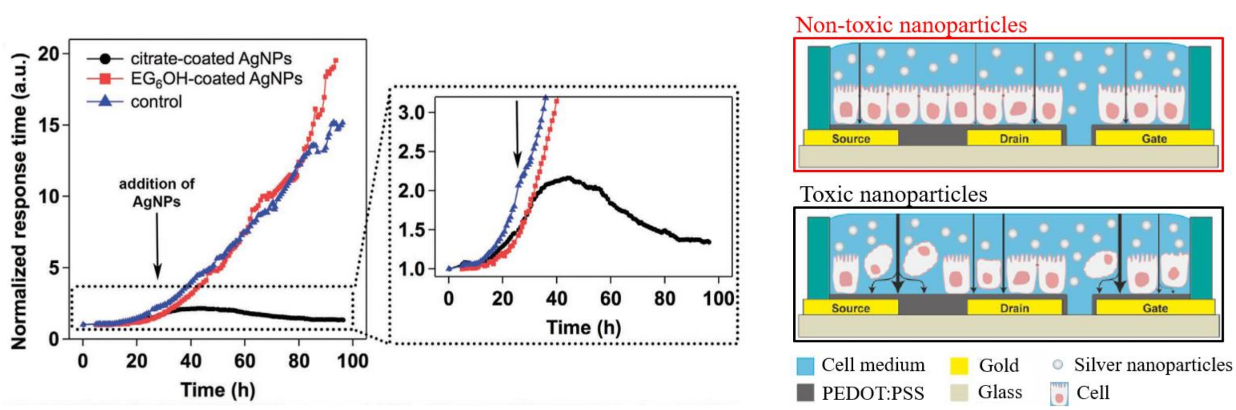

Figure 1: Left: OECT real-time monitoring of Caco-2 cell lines, incubated with toxic (black) and non-toxic (red) Nanoparticles, as exogenous agents. A standard, healthy Caco-2 growth is reported as the control (blue). Right: schematic of the cytotoxicity effect induced by toxic Nanoparticles (black) over the cell lines and the subsequent ion lux modifications, with respect to non-toxic Nanoparticles (red).

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