Real-time monitoring of drug-induced cytotoxicity kinetics using a tailor-made impedance platform

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Published in:
Proceedings of the 15th International Conference on Electroanalysis

Publication date:
2014

Real-time monitoring of drug-induced cytotoxicity kinetics using a tailor-made impedance platform

Claudia Caviglia, Silvia Canepa, Kinga Zór, Arto Heinskanen, Thomas Lars Andresen and Jenny Emnéus*

Department of Micro- and Nanotechnology, Technical University of Denmark (clauc@nanotech.dtu.dk)
*Department of Micro- and Nanotechnology Technical University of Denmark

Monitoring of cellular activities, such as cell invasion, proliferation, differentiation and cell death play a key role in understanding cellular behavior and opens up possibilities to unravel new biological events critical in cancer research and drug screening [1]. Electrochemical Impedance Spectroscopy (EIS) has been proved to be a powerful, label-free and minimally invasive biophysical approach for continuous, real-time investigation of specific physiological and morphological changes of adherent cells [2]. During the last two decades different custom-made impedance-based systems have been designed and used for studying cellular activities, such as cell adhesion and spreading [3], proliferation and cytotoxicity [4].
In this work, a tailor-made impedance-based platform [5] has been used to monitor in real-time the kinetics of drug-induced cytotoxicity using Doxorubicin (DOX) as a model compound. A systematic study has been carried out in order to evaluate different parameters that can alter the cell-substrate interaction and therefore be critical in cell-based impedance measurements. In particular, in order to perform reliable biological assays, environmental factors (evaporation, medium acidification, mechanical perturbations, and temperature fluctuations), potential perturbations and cell density have been considered.
The time dependent kinetic response of DOX, a well-know chemotherapeutic drug, has been evaluated on different densities of HeLa cells (12.500, 35.000 and 75.000 cells/cm^2) (Figure 1) and a correlation between the time dependent kinetic action of the drug and the cell density has been found (Figure 1 insert). The obtained results have been verified and compared with data obtained from MTS assays performed under the same experimental conditions. MTS assay does not provide a detailed overview of the kinetic of the biological events, proving the great advantages of the impedance approach for studying specific biological problems.

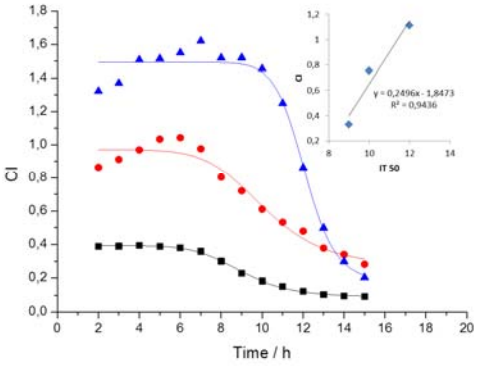

Figure 1. Impedimetric profiles relative to three different populations of HeLa cells when treated with 5µM of DOX. The insert represents the correlation between the cell density and the time-dependent kinetic response.

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