Lab-on-a-Chip systems for the evaluation of new anticancer therapeutical methods

Michał Chudy[1]

1. Warsaw University of Technology, Faculty of Chemistry, Department of Microbioanalytics, 00-664 Warsaw, Poland

Development of new therapeutical anticancer methods is an important step in evolution of medicine. Both, newly synthesized and allowed for preclinical studies drugs are tested in high-throughput assays using 96-well plates. A rapidly growing pharmaceutical industry requires faster and more efficient ways to find and to test new drugs and methods. Scientists are still working on new *in vitro* methods and models for cytotoxicity testing, which will mimic growth *in vivo* conditions. One of the new methods for cell culture and examining the toxic effects of drugs is application of microfluidic systems (*lab-on-a-chip*).

Microsystems are an alternative tools for drug testing, therapies evaluation and new tumor model studies, which can be used in biological laboratories. The size scale of microfluidic devices is especially suitable for biological applications at the cellular level, because the scale of microchannels corresponds well with the native cellular microenvironment. Moreover, the ability for geometry modification of a microdevice gives the possibility of growth factors, reagents and oxygen control inside the system, as well as hydrodynamic shear of stress upon the cultured cells.

We developed hybrid microfluidic culture systems which are applicable for cell engineering. The designed geometry of the microdevices includes cell culture microchambers both for monolayer and (Multicellular Tumor Spheroids – MCTS) 3D culture and a concentration gradient generator (CGG). In the designed microsystems various cell lines were cultured and analyzed. Monolayer and 3D cell culture, cell based cytotoxicity assays and photodynamic therapy procedures PDT were evaluated in the fabricated microsystems and compared with the results obtained during classical macroscale experiments with cells cultured in flasks. Moreover, we developed the new multi-function microsystem for simple cell lines introduction and cultivation of two adherent cell types. This microdevice is a convenient tool for cell-based applications such as cell migration studies cell co-culture and mixed cellculture, toxicological test as well as new drug and evaluation how the presence of another cell type influence on cells viability after PDT procedure.

Application of developed Lab-on-a-Chip microfluidic devices can significantly improve biological, cell engineering and anticancer studies. They can be user-friendly devices applicable in biological laboratories. Microsystems developed in our group can have numerous applications in studies on new anticancer drugs, activity of photosentitizers for PDT and cell-cell interactions' evaluation.

Acknowledgements
This work was financially supported by Warsaw University of Technology

Correspondence author
Michał Chudy, Prof.PW.
chudziak@ch.pw.edu.pl