

Bioanalytics On Microchips: About Cell Screenings And Artificial Cells

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Nowadays, microfluidic devices are useful tools in various research fields and industrial applications. Both analytical and synthesis processes on chip have been of interest within the last 20 years. In many studies, highly integrated systems have been presented, in which automated multi-step processes could be performed. Indeed, a trend to complete and sophisticated devices can be noticed having outstanding performance with respect to quality, sensitivity and speed. Furthermore, the dimensionalities of structures fabricated by means of microsystems technology are matching biological relevant length scales; hence, valuable platforms for cell analysis and cultivation can be designed, and completely new applications without macroscopic equivalent can be developed. In this presentation, novel approaches towards microfluidic bioanalytical and cell-screening platforms will be presented. Particularly, the benefits of bi-layer microfluidic chips will be emphasized. In general, microfluidic chips have a planar design, i.e., a channel system is fabricated into a substrate and is closed by a cover plate or foil so that all processes are performed in a downstream mode. However, the introduction of a second fluidic layer enables further spatial and temporal control concerning cell handling and analyte supply. The applicability of such bi-layer microchips has been proven in several cell studies focussing on chemotaxis and on monitoring protein expression levels.

Living cells are complex systems though. A versatile approach for many applications is the use of artificial, cell-like objects such as lipid vesicles. With the goal to study binding processes at the membrane and permeation processes through the membrane, we develop micro-cytometric platforms to detect and analyse vesicles by means high-sensitivity single-molecule fluorescence spectroscopy. Moreover, the unique properties of micro-scaled devices, i.e. small feature dimensions and the laminar flow regime, provide the requirements to form and stabilise vesicular structures with various, extraordinary morphologies. Such structures may help to systematically investigate membrane properties and to understand the fundamentals of cellular architecture.