Microfluidics technology for manipulation and analysis of biological cells

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Abstract: Analysis of the profiles and dynamics of molecular components and sub-cellular structures in living cells using microfluidic devices has become a major branch of bioanalytical chemistry during the past decades. Microfluidic systems have shown unique advantages in performing analytical functions such as controlled transportation, immobilization, and manipulation of biological molecules and cells, as well as separation, mixing, and dilution of chemical reagents, which enables the analysis of intracellular parameters and detection of cell metabolites, even on a single-cell level. This article provides an in-depth review on the applications of microfluidic devices for cell-based assays in recent years (2002-2005). Various cell manipulation methods for microfluidic applications, based on magnetic, optical, mechanical, and electrical principles, are described with selected examples of microfluidic devices for cell-based analysis. Microfluidic devices for cell treatment, including cell lysis, cell culture, and cell electroporation, are surveyed and their unique features are introduced. Special attention is devoted to a number of microfluidic devices for cell-based assays, including micro cytometer, microfluidic chemical cytometry, biochemical sensing chip, and whole cell sensing chip.

Author Keywords: Biochip; Cell analysis; Cell manipulation; Lab-on-a-chip; Microfluidic devices; Miniaturized total analysis system

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