Cells-on-chip: new vistas for experimental nano-oncology and personalized therapy

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Abstract:

The ever increasing importance of cell-based assays in the post-genomic era necessitates development of novel and cost-effective screening solutions. The parallel acquisition of spatiotemporal data on a multitude of cellular inputs and outputs is particularly important in the research on tumor and stem cell biology. The regulation of pharmacologically induced tumor cell death, for instance, is a perfect example where multiple and variable molecular switches act at the same time. This requires an experimental investigation of large numbers of single cells kinetically and multiparametically. Discrete data sets and fluctuations in molecular signaling networks are, however, still largely inaccessible by conventional, macroscale experimental approaches.

Over the last few years exciting technological advances in Lab-on-a-Chip (LOAC) technologies have been made that allow dynamic studies of single cell physiology with an unprecedented accuracy. The explosion of replica molding with biocompatible silicone elastomers allows rapid and straightforward prototyping of complex microfluidic devices. The confining dimensions of the microfluidic structures facilitate precise positioning of cells and sequential delivery of drugs and/or functional probes to the distinct cell microenvironment. Most importantly, however, the laminar flow has the potential to deliver

drugs and nanosensors to discrete subcellular domains, a feature not attainable with any marcoscale technology

As the interest in the microfabricated technologies and nanobiotechnology is rapidly gaining momentum I highlight the most promising LOAC technologies that provide new vistas for the experimental oncology and personalized diagnostics. It is anticipated that advances in such single cellOmic technologies should aid in tailoring of investigational therapies and support the current computational efforts in the systems biology.