THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY
Nano Science and Technology Program

PhD Thesis Presentation

" Fabrication of Microfluidic Devices and their Applications in Chemical and Biological Analysis "

by
Mr. Yihua ZHAO

Abstract

Microfluidic technologies are emerging as powerful tools for biological study including tissue, single cell or even single molecule level analysis in parallel. A small volume reaction and delivery not only enhances the speed of analyses but also enables the high throughput in automation form. Regarding of the superior of microfluidics applied in biological study, my PhD work focus on developing new microfluidic devices to study cell mechanics, subcellular level bio-detection, and new methods to fabricate 2D or 3D scaffolds for tissue engineering, which can be applied in biological study.

In this thesis, we first develop a Teflon-base lithography method, which enables the fabrication of either organic or inorganic materials in sub-micron level. We adopt the Teflon-based lithography method to pattern microgrooves of drug-laden poly (lactic-co-glycolic acid) (PLGA), which can be used for engineered tendon-repair therapeutics. Furthermore, we employ one Teflon series polymer-perfluoropolyether (PFPE) to encapsulate single-cells in each PFPE microcapsules. These PFPE microspheres can serve as robust and inert nanoliter reactors for single-cell analysis.

In the second part, we develop a convenient miniaturized 3D platform which could allow high-throughput analysis of the effects of mechanical strain. We demonstrate the capability of this array of microlenses as a general platform for studying the influence of mechanical strain on adherent cells by using NIH 3T3 fibroblasts and HeLa cells as our models.

In the last part, we explore novel methods to fabricate complex 3D microstructures. We first demonstrate one-step direct molding method to fabricate 3D microstructure using the cracked PDMS master. We also present a direct-writing strategy to fabricate 1D and 3D vascular-like microchannels with micropatterned surface in hydrogels. Our methods for fabricating complex 3D microstructures may find application in tissue engineering.

Date: August 9, 2013 (Friday)
Time: 2:30pm
Venue: Room 4472 (via Lifts 25-26)
Academic Building, HKUST

All interested are welcome!