Combined Micro-Contact Printing and Microfluidic Patterning of Biomarkers in a Microfluidic Device

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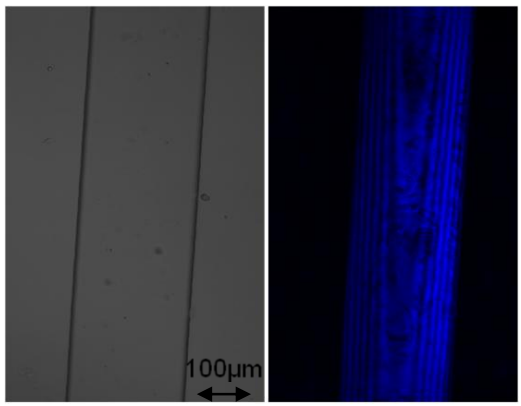
Statement of Purpose: Surface functionalization is an important step in a variety of Lab-on-Chip devices in applications such as cell sorting, cytosensors, diagnosis, stem cell enrichment and regenerative medicine [1]. Controlling the concentration of the biomarkers on the surface as well as creating desired patterns of these biomolecules with controlled orientation and durable bonds are the main concerns for surface engineering in microchips. Despite extensive work in the field, surface preparation for lab-on-chip devices remains an area with great potential towards controlled selectivity and desirable gradient of surface biomarkers while creating durable biomarker-surface bonds. The surface patterning techniques should be selective, fast and implementable within the fabrication limitations of microfluidic devices. In this report, we propose a new method which combines µ-contact printing and microfluidic printing to create a detection interface onto the surface of the microchannels in a microfluidic platform. The results for patterning anti-CD34 (a specific biomarker for vascular and hematopoietic stem cells) onto the surface of the microchannel was verified using X-ray photoelectron spectroscopy (XPS) and fluorescent microscopy.

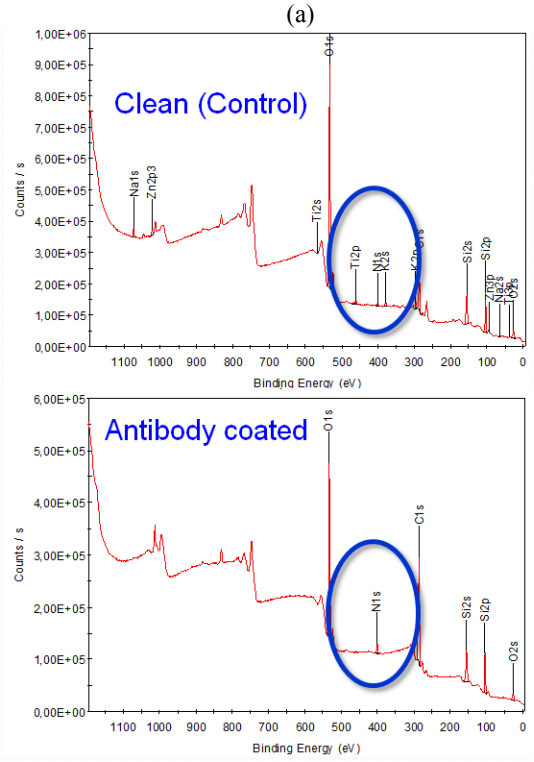
Methods: PDMS-glass based microfluidic platform and the PDMS stamp for µ-contact printing was fabricated using soft lithography technique. First, the pattern is transferred onto a silicon wafer coated with SU-8 photoresist to fabricate the mold for soft lithography. This part of the fabrication was performed in a cleanroom. The fabricated platform is used as a mold to transfer the pattern onto the PDMS surface. The PDMS patterned substrate is then peeled off and bonded to the glass substrate using plasma treatment. Before bonding the substrates the cell-specific biomarker is patterned onto the glass surface by µ-contact printing. X-ray photoelectron spectroscopy (XPS) was used to investigate the printed surface. After connecting the tubing, the surface is passivated by flowing the blocking solution through the channel. After washing the surface with PBS the secondary antibody is flowed into the channel at a flow rate of 70µl/min to create the possibility of detecting the results with fluorescent microscopy.

Results: Figure 1a shows one of the microchannels in the microfluidic platform functionalized with anti-CD34. The proof of concept for surface functionalization with a desired pattern in flow conditions has been presented. Figure 1b depicts the results of XPS survey analysis on the patterned surface. The elemental analysis shows that the concentration of nitrogen on the patterned areas increases from 0.47% to 6.1% after patterning the antibody onto the surface.

Conclusions: Microfluidic patterning combined with µ-contact printing was used to functionalize the surface of the microchannels in a microfluidic platform.



(a)



(b)

Figure 1. a) Florescent microscopy for patterning anti-CD34 onto microchannels surface, b) XPS analysis of glass surface printed with antibody

The developed platform can be used in different biosensing applications such as detection and sorting of different cell types.

References:

[1] T. F. Didar and M. Tabrizian, Lab on a Chip, vol. 10, pp. 3043-3053, 2010.

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