

Experimental Studies on the Effects of Surface Treatment Materials on Cell Trapping Micro-cavities Template

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Keywords: Cell Trapping, Surface Modification, Microfabrication

Atomic Force Microscopy (AFM) has been used to interrogate the bio-chemical and interfacial mechanical properties of cell surfaces [1]. Micro-cavity templates have previously been suggested to limit cell movement during AFM imaging and sensing, particularly for malignant Ramos B cells [2]. However, the interpretation of the AFM measurements is complicated by the observation that additional cells also attach from the top surface and contact those within the micro-cavities. This work investigates the effect of different hydrophobic materials, i.e. 3-aminopropyl triethoxy silane (APTES), Parlyene C and CYTOP, on the top surface to overcome this issue. All three materials are explored in a single study [3] on the impact of the cavity-trapped cells.

Micro-cavities templates were fabricated on 150 mm diameter glass substrates as illustrated in Figure 1. These templates with diameter of 15µm, 20µm and 25µm were formed using a ten micron thick SU-8 3025 through photolithography. Three different types of materials were used to create a more hydrophobic environment on the top surface of the template to encourage cells to reside in the micro-cavities. The APTES was deposited onto the micro-cavities using the Cambridge Nanotech Savannah Self Assembled Monolayer (SAMS) system. Parlyene C was deposited onto the template using the SCS Labcoater. 1 gram of Parlyene C dimer was loaded into the SCS Labcoater to form a 100nm thick coating. The CYTOP was deposited onto the micro-cavities via a spin on technique. The CYTOP CTL 809-M is mixed with CT-Solv 180 to form a teflon-like solution. The solution is then spun onto the template using a spin coater, followed by a 180°C bake to cure the material, forming a hydrophobic surface. All three surface modified templates were then patterned using S1813 with the micro-cavities exposed, followed by an oxygen treatment to neutralize the hydrophobicity in the exposed area. The photoresist was removed and the templates were then used in cell culturing and cell immobilization experiments.

Malignant Ramos B cells were used in the cell trapping experiment which employed 4 different substrates, i.e. the 3 treated surfaces and an untreated control template. All templates were coated with Poly-L-Lysine (PLL), followed by the application of cells onto them. Figure 2 shows a HIM micrograph of random distribution of cell on an untreated template. Some cells were seen attached to the treated surface and in micro-cavities of the CYTOP and Parlyene C templates were observed. Figure 3 shows an APTES coated template with more cells being trapped in the micro-cavities with very few cells observed on the treated surface.

Clearly, these coatings improve the quality of a low cost cell-trapping template platform suitable for suspension cells. The trapping tests showed that the APTES coated SU-8 template with the aid of PLL coating produces the better trapping results as compared to Parlyene C and CYTOP.

References

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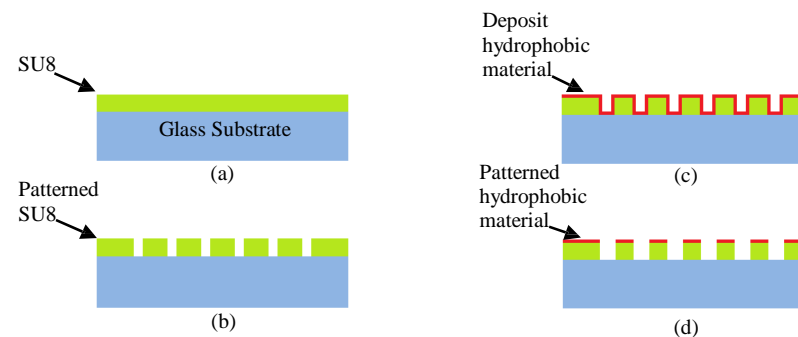


Figure 1. Fabrication flow of cell trapping template. (a) Spin 10µm of SU8-3025 onto glass substrate. (b) Form micro-cavities through optical lithography to form cell trapping template. (c) Deposit surface modification material onto the template. (d) Expose the microcavities to oxygen plasma to remove/neutralise hydrophobic material/effect.

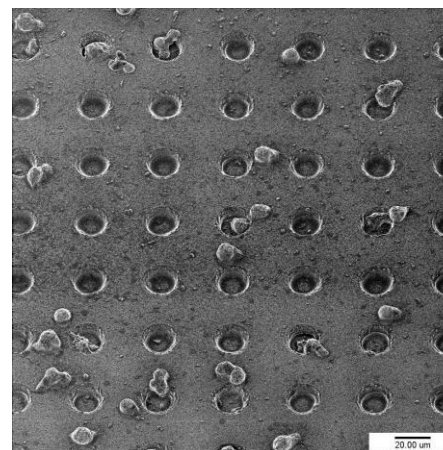


Figure 2. Helium Ion Microscope (HIM) micrograph taken at a tilted angle of 36° showing random distribution of cells over an untreated template after cell trapping experiment

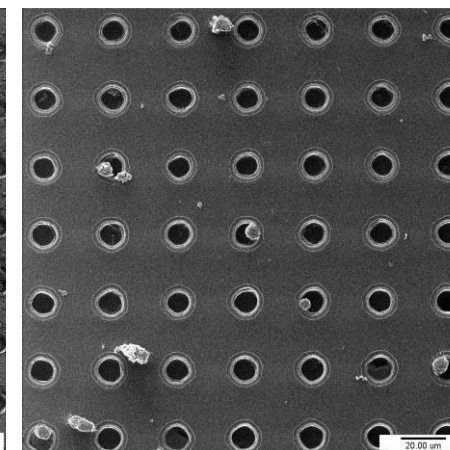


Figure 3. Helium Ion Microscope (HIM) micrograph taken with zero tilt angle showing cells limited within the micro-cavity template with APTES coating.