

MICROMACHINED PDMS ELASTIC POST ARRAYS FOR STUDYING VASCULAR SMOOTH MUSCLE CELLS

Qi Cheng

Dr. Mahmoud Almasri, Dissertation Supervisor

ABSTRACT

This thesis describes the design, modeling, fabrication and characterization of a micromachined array of high density 3-dimensional microposts (100×100) made of flexible material (silicone elastomers) for use to measure quantitatively the cellular traction force generated by vascular smooth muscle cell (VSMC) with high sensitivity and accuracy. The micropost arrays were then fabricated with diameters ranged from 3 to 10 μm , with edge to edge spacing of 5 and 7 μm , and with a height to diameter aspect ratio up to 13 using microfabrication techniques and replica molding. The mechanical properties of the Polydimethylsiloxane (PDMS) microposts with various geometries used in the cell culture experiment were determined experimentally including detailed measurements of Young's modulus (E) and the corresponding spring constant. We have found that microposts with different sizes and geometries have different Young's.

Vascular smooth muscle cells were cultured on top of the micropost arrays and incubated for 2 days before an image acquisition experiment.. The micropost arrays with different geometries were used to study VSMCs. We have found that the traction force exerted by VSM cell increases as the stiffness of the micropost increases. It demonstrates that VSM cell tends to adjust its traction force to adapt to its physical environment.

VSMCs with integrin-linked kinase enzyme (ILKE), referred to as CK_4 cell, and without ILK module, referred as ILK cell, were also studied using PDMS micropost array. This study indicates that the function of ILK molecule is involved to the VSMC contraction and the control its traction force. Finally, high temporal resolution analysis of CK_4 cells was performed on PDMS micropost array.