Rapid prototyping of micropatterned cells by liquid-crysital-display projection method

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Introduction: Microfabrication techniqhes such as photolithography have been applied to micropatterning of polymers, biomolecules and cells. However, most of microfabrication techniques require specialized equipment and the preparation of photomasks, resulting in costly and time-consuming processes. We have developed an all-in-one device by utilizing a commercially available liquid crystal display projector (LCDP) for exposure of patterned images, which were generated on personal computer (PC), thorough the reduction lens[1-3]. This device facilitates preparation of micropatterned hydrogels[1] and poly(dimethylsiloxane) (PDMS) microchannels[2, 3] without the need for photomasks. In this work, we describe a simple and reliable fabrication method for a rapid prototyping of micropatterned cells by liquid-crystal-display projection method (Fig. 1).

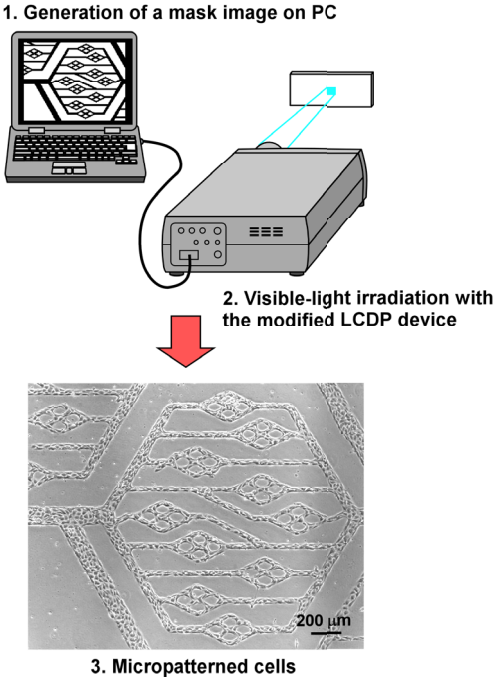

Fig. 1 Schematics of rapid prototyping of micropatterned cells using the modified LCDP device.

Methods: 3-Methacryloxypropyltrimethoxysilane (MPTMS)-immobilized coverslip coated with g-line positive photoresist was irradiated with modified LCDP device. After irradiation for 3 min, the coverslip was developed in alkaline solution to dissolve the irradiated areas of the positive photoresist. Polymerization of acrylamide (AAm) in water was performed with potassium peroxodisulfate as an initiator to immobilize polyacrylamide (PAAm) onto the silanized glass surface. Finally, the photoresist was dissolved in acetone, resulting in formation of the micropattern with PAAm and silanized domains on the coverslip surface. Endothelial cells (ECs) were seeded onto the PAAm–silanized micropatterned surfaces. Morphology of cultured cells on the patterned surfaces was observed under a phase contrast microscope.

Results / Discussion: In order to visualize PAAm–silanized micropatterns, fluorescein isothiocyanate-conjugated bovine serum albumin (FITC-BSA) adsorbed onto the micropatterned surfaces was observed under a fluorescent microscope (Fig. 2a). The selective adsorption of FITC-BSA was detected only in the area of the silanized surfaces. Immobilized PAAm on the surfaces is known to repel protein adsorption, thus leading to the accumulation of FITC-BSA only to the silanized areas. ECs were then plated onto the PAAm-micropatterned surfaces (Fig. 2b). Cells seeded on the micropatterned surfaces attach and spread only on silanized glass surfaces, conforming to the pattern design. Cell adhesion to PAAm-grafted areas was consistently inhibited.

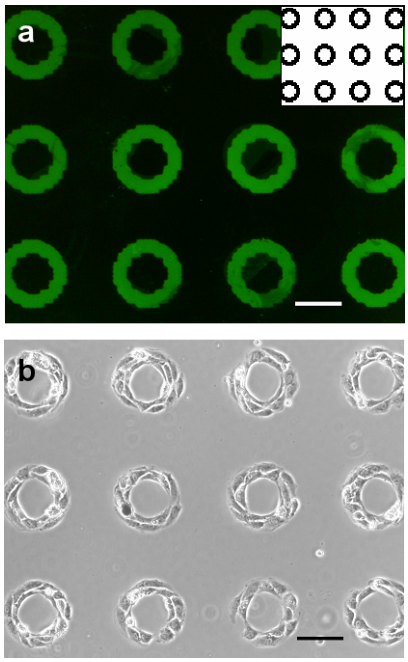

Fig. 2 a) FITC-BSA adsorbed on PAAm-micropatterned surfaces was detected by fluorescence microscopy. The mask image is shown at reduced size in the upper right corner. b) BCs on the PAAm-micropattetns were observed by phase contrast microscopy. Scale bars: 100 μm.

Conclusions: Micropatterned cells were prepared easily and quickly without the need for any expensive photomasks and facilities for photolithographic microfabrication. This technique with the modified LCDP device should be useful for the preparation of micropatterned surfaces for some biomedical applications.

References:

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3. Kobayashi J et al. Adv Mater. 2004;16:1997-2001.