**Micropatterning of Hydrogels by Visible Light Irradiation with Maskless Photolithography Device**

Jun Kobayashi, Kazuyoshi Itoga, Masayuki Yamato, Teruo Okano
Institute of Advanced Biomedical Engineering and Science, Tokyo Women's Medical University

**Statement of Purpose:** We have developed a maskless photolithography 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 (Itoga et al., 2004; Itoga et al., 2008). Surface patterning of poly(ethylene glycol) (Itoga et al., 2004) and poly(isobornyl acrylate-*co*-tetraethylene glycol dimethacrylate) (Kobayashi et al., 2004) on the coverslip was performed by irradiation of visible light through patterned images on the liquid crystal panel. During photopolymerization of liquid monomers, however, generated radical species diffuse from the exposed area toward vertical or lateral directions, broadening the polymerized features. To eliminate the effect of diffusion, allowing for more precise control of surface micropatterning, photoreactive materials is coated on the polymeric substrate as solid state during irradiation. In this study, a new surface micropatterning with camphorquinone derivatives is performed by visible-light induced reaction using the modified liquid crystal display projector.

**Methods:** A typical preparation procedure for preparation of camphorquinone derivatives follows: the copolymer having primary amino groups along the side chain was obtained from random radical polymerization of 2-aminoethyl methacrylate hydrochloride and N,N-dimethyl- acrylamde. After coupling of 7,7-dimethyl-2,3-dioxobicyclo[2.2.1]heptane-1-carboxylic acid with the copolymer, yellowish solid was obtained. Immobilization of the copolymer having camphorquinone moieties on the polymeric substrate was performed by irradiation with visible light such as blue diodes and maskless photolithography device (Figure 1).

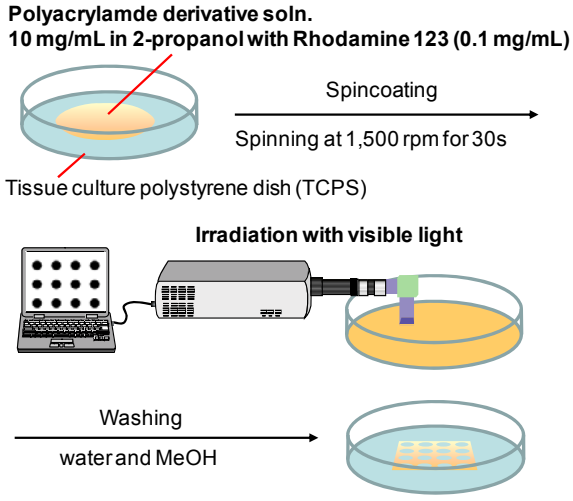


Figure 1. Surface micropatterning of poly(*N*,*N*-dimethylacrylamide) having camphorquinone groups by maskless device.

**Results:** Formation of micropatterned hyrogel layer was observed by bright field (Figure 2) and fluorescent microscopy (Figure 3). By irradiation of visible-light, the copolymer having camphorquinone moieties generate radicals by abstraction of hydrogen from neighboring polymers, and couple between camphorquinone moieties and the substrate, leading to the immobilization of the coplolymer on the surface. Moreover, the irradiated surface area exhibit repealing protein/cell adhesion arising from hydrophilic polymer such as polyacrylamide and poly(ethylene glycol).

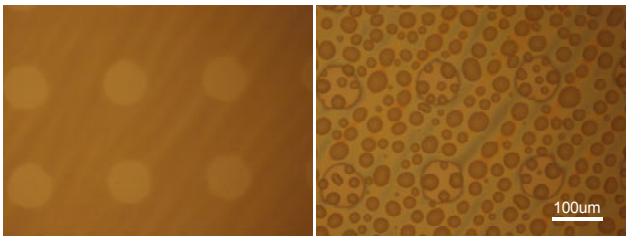


Figure 2. Bright field microscopic images of micropatterned polymers on TCPS.

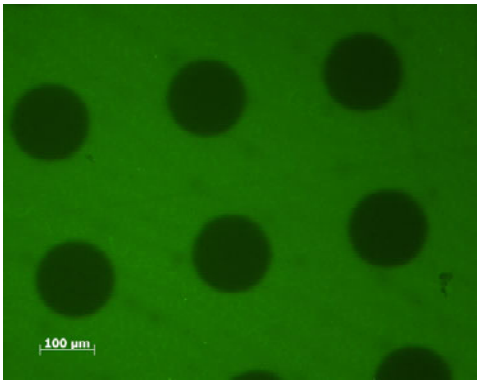


Figure 3. Fluorescent microscopic images of micropatterned polymers on TCPS.

**Conclusions:** With maskless photolithography device, micropatterned hydrogels were prepared easily and quickly without the need for any expensive photomasks and facilities for photolithographic microfabrication. This technique for micropatterned hydrogels would be applied to fabrication of micropatterned cells and microfluidic channels.

**References:**

Itoga K, Yamato M, Kobayashi J, Kikuchi A, Okano T. Biomaterials. 2004; 25:2047-2053.
Itoga K, Kobayashi J, Tsuda Y, Yamato M, Kikuchi A, Okano T Anal Chem. 2008;80:1323-1327.
Kobayashi J, Yamato M, Itoga K, Kikuchi A, Okano T. Adv Mater. 2004;16:1997-2001.