Fabrication of paper-based microfluidic analytical devices using a laser beam scanning technique

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[Introduction] Paper-based microfluidic analytical devices (μPADs) have attracted great interest because they possess advantages such as inexpensive, easy-to-use, biocompatible. The methods such as wax printing, ink jet etching, plotter printing have been used to create the hydrophobic-hydrophilic patterns on the μPAD. These methods physically generate the hydrophobic barrier on the surface of devices. Photolithography technique, recently, has been applied to generate organosilane-based self-assembled monolayers on the surface of materials. This research used photomasks to shape the patterns. In this study, we aim to fabricate the μPADs using a laser beam scanning technique.

[Experiment] A chromatography paper (Advantec Co., Ltd.) with a size of 40mm×60mm was immersed into octadecyltrichloro silane (OTS, Sigma Aldrich-Merck Co.) in *n*-hexane (Wako pure chemical industry, Ltd, analytical grade) (0.1% v/v) in 5 minutes at room temperature. The paper was taken out and rinsing with *n*-hexane and ethanol (Wako pure chemical industry, Ltd, analytical grade), respectively. Nitrogen (N_2) gas was used to dry the paper. This hydrophobic paper was immersed into chloroform ($CHCl_3$, Wako pure chemical industry, Ltd, analytical grade). Then it continues to be dipped into CPI-410s 5% (San-Apro Co, Ltd.) which was dissolved in the dimethyl sulfoxide (DMSO, Wako pure chemical industry, Ltd, analytical grade). A xenon lamp (L2274, 150W, Hamamatsu photonics K.K.) system was used to illuminate the hydrophobic pattern through a photomask in 50 minutes. Then the paper was rinsed with DMSO and $CHCl_3$, respectively. To examine the wettability of the paper, we drop the disodium;5-acetamido-4-hydroxy-3-phenyldiazenylnaphthalene-2,7-disulfonate solution 10% (acid red 1, Sigma Aldrich-Merck Co.) on the irradiated area of the paper. Another red 1 droplet (5μl) was put on the masked zone.

[Result and discussion] Fig. 1 shows the difference between the hydrophilic and hydrophobic regions on the paper. The upper part was the hydrophilic area. When liquid droplet was put on, it quickly spread out on the surface of the hydrophilic zone. The lower part is the hydrophobic field (the masked zone). It still remained hydrophobic property. The liquid droplet did not spread across the surface. We initially succeeded to fabricate hydrophobic-hydrophilic pattern on the paper by using photochemical reactions.

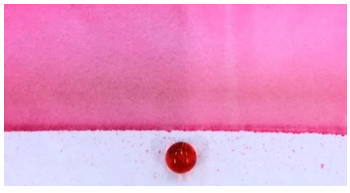

Fig. 1 Image of the hydrophobic and hydrophilic zones on the paper