A simple method using two-step hot embossing technique with shrinking for fabrication of cross microchannels on PMMA substrate and its application to electrophoretic separation of amino acids in functional drinks

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This work presents a simple hot embossing method with a shrinking procedure to produce cross-shape microchannels on poly(methyl methacrylate) (PMMA) substrate for the fabrication of an electrophoresis chip. The proposed method employed a simple two-step hot embossing technique, carried out consecutively on the same piece of substrate to make the crossing channels. Studies of embossing conditions, i.e. temperature, pressure and time, were carried out to investigate their effects on the dimension of the microchannels. Applying a simple shrinking procedure reduced the size of the channels from 700 ± 20 µm wide × 150 ± 5 µm deep to 250 ± 10 µm wide × 30 ± 2 µm deep, i.e. 80% and 64% reduction in the depth and width, respectively. Thermal fusion was employed to bond the PMMA substrate with a PMMA cover plate to produce the microfluidic device. Replication of microchip was achieved by precise control of conditions in the fabrication process (pressure, temperature and time), resulting in lower than 7% RSD of channel dimension, width and depth (n = 10 devices). The method was simple and robust without the use of expensive equipment to construct the microstructure on a thermoplastic substrate. The PMMA microchip was used for demonstration of amine functionalization on the PMMA surface, measurement of electroosmotic flow and for electrophoretic separation of amino acids in functional drink samples. The precision of migration time and peak area of the amino acids, Lys, Ile and Phe at 125 µM to 500 µM, were in the range 3.2–4.2% RSD (n = 9 devices) and 4.5–5.3% RSD (n = 9 devices), respectively.
Reference: