Flow-Restricted Etching Method on Isotropic Substrates and Its Mechanism

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Abstract: With the development of analytical instrumentation to minimization, integration and automation, the microfluidic chips, which are more integrated, complex and diversified, have been applied widely on the manufacturing of analytical instrumentation. However, the present photolithography-based microfabrication technology, which is only able to pattern microchannels with simple inside structures, can not follow the rapid development of requirements. For solving the problem, a fabrication method based on the restricting effect of laminar flow is proposed for the micro etching on isotropic substrates. Experiments were conducted inside glass-based microchannels, in which certain etchant was used to form complicated microstructures. The flow parameters' effects on the aspect ratio, side wall profile and etching rate were revealed by the experiments. The experimental results reveal that the topography of micro structures patterned with the restricted flow etching method is mainly determined by the flowrates of separator and etchant. The computational fluid dynamics(CFD) model on the interface between multiple streams was established for the etching process, and analysis on the causes of various micro topographies was conducted based on the CFD simulation results. The experimental data consisted with the simulation results very well. The investigation depicted in this paper indicate that the flow restricted etching method provides sufficient references for the research and understanding on the mass transport at the liquid-liquid surface in the microchannel and can be used to pattern complex micro structures with high aspect ratios, meantime, it greatly enriches the microfabrication technology for microfluidic chips.
Key words: microfluidics, etching, computational fluid dynamics(CFD), laminar

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