

Glass microchannel technology for capillary electrophoresis

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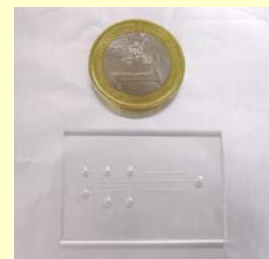
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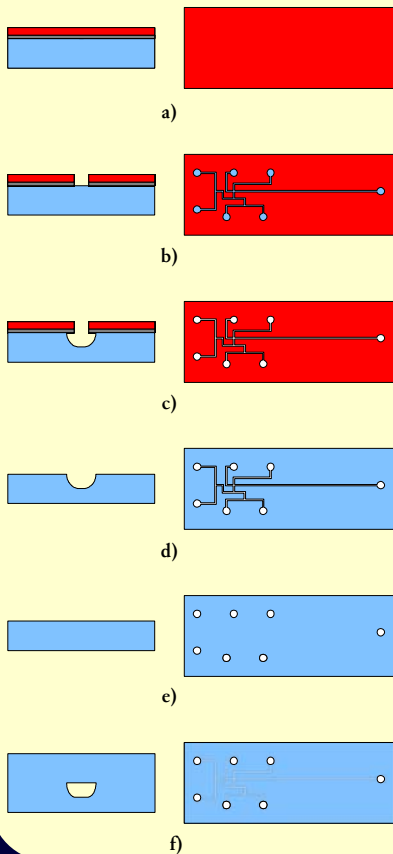
The crossover of microfabrication technology from the integrated circuit industry into analytical chemistry has led to a considerable increase in the number of integrated microfluidic devices, known as micro total analysis systems (μ TAS) or lab on a chip (LOC), which are able to perform analytical functions required by an analysis. Among them, chips for chemical analysis have been considered one of the most promising due to their short analysis times, high separation efficiency, high sample throughput, minute samples and reagents consumption and easy automation. In these applications, glass is the preferred material due to its good optical properties, well-known surface characteristics and high breakdown voltage. Differently from silicon, the micromachining of glass is not already standardized especially for what concerns the etching mask and bonding.

Structure Description

We propose a fabrication process for capillary electrophoresis devices based on selective wet etchings and fusion bonding. A device made up of two $26 \times 40 \text{ mm}^2$ glass substrates each of them $800 \mu\text{m}$ thick with five microchannels, four for the sample injection and one for the separation, has been fabricated. The separation channel is $80 \mu\text{m}$ wide, $25 \mu\text{m}$ deep and 20 mm long while the other channels have the same depth and width but are 9 mm long. Access points to the channel reservoirs have been provided by 1 mm holes, made in the second substrate by means of diamond drills. In figure the device at the end of the process is shown.



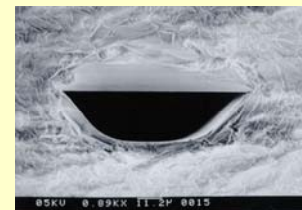
Fabrication process



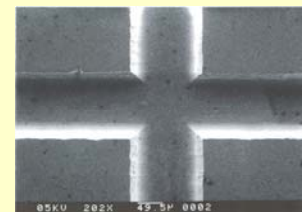
The fabrication process schematically consists in the following steps:

- Deposition of a 800 nm thick chromium layer on a glass substrate by means of e-beam evaporation (temperature: $280 \text{ }^\circ\text{C}$, pressure: $1.4 \cdot 10^{-6} \text{ TORR}$, deposition rate: $1.5 \text{ \AA}/\text{sec}$).
- Standard optical lithography ($1 \mu\text{m}$ resolution) of a 1500 nm thick photoresist (Microposit S1818) layer to define the microchannels pattern.
- Chromium etching with a ceric ammonium nitrate $((\text{NH}_4)_2\text{Ce}(\text{NO}_3)_6)$, perchloric acid (HClO_4) and deionized water mixture for 2 min at room temperature.
- Glass etching with a hydrofluoric acid (HF), nitric acid (HNO_3) and deionized water mixture (1:1:5). The etching was performed at the temperature of $38 \text{ }^\circ\text{C}$, with a rate of $4.5 \mu\text{m}/\text{min}$.
- Drilling of 1 mm holes in the second substrate by means of diamond drills.
- Cleaning of two substrates in a sulfuric peroxide solution at $120 \text{ }^\circ\text{C}$ for 20 minutes and by successive washings with acetone, ethanol and deionized water in ultrasonic bath.
- Joining of the two glass substrates by fusion bonding at $620 \text{ }^\circ\text{C}$ for 1 h in a muffle oven.

Experimental results



SEM photo of a microchannel cross section with a depth of $25 \mu\text{m}$ and a width of $80 \mu\text{m}$ after the fusion bonding: no separation surface is visible between the two glass substrates, confirming the good quality of the bonding.



A SEM photo of the intersection point between the channels: well defined intersection volume ensures correct substances mix.

Acknowledgements

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