Fabrication of Nanochannels in Glass

CNF Project # 1096-02

Principal Investigator(s): Lukas Novotny

Abstract:
The current project has been dedicated to fabricating 500 nm wide and 500 nm deep channels in glass wafers.
Each wafer assembly consists of two glass wafers bonded to each other, and it contains eight flow-cells, isolated from each other. Each flow-cell consists of two reservoirs, 30 mm away from one another, and a 2 mm wide and 500 nm deep channel which connects these reservoirs. Halfway from the reservoirs, the channel is divided by a 15 µm wide and 500 nm high ridge, in which 500 nm wide channels are made.
In the past years, the nanochannels were used in the project for developing a new method for nanoparticles recognition [1, 2]. Nanoparticles are recognized by measuring the optical force acting on nanoparticles in a strongly focused laser beam [3]. Currently, the nano-channels are used in the project for single viruses recognition and classification.

Fabrication Procedure:
A borosilicate glass wafer (Schott Glass, Germany) was precleaned in RCA1 solution at 70°C for 20 minutes. The wafer was vapor primed in the YES oven. The wafer was spin-coated with i-line photo-resist (OiR 620-7i) at 3000RPM for 30 seconds with three seconds ramping speed. The nano-sized parts of the flow-cell were patterned using the 10X stepper (GCA corp., Andover, MA), and the micro-sized features were patterned using the EV602 contact aligner (Electronic Visions, Phoenix, AZ). The channels were etched using reactive ion etching technique in the Plasma Therm 72. The remaining resist was then removed by soaking the wafer in nano-strip solution at 80°C for 10 minutes. A second glass wafer was used to seal the channels. Holes for liquid delivery were made in the second glass wafer using a sand-blasting tool. Two wafers were cleaned in the RCA1 cleaning solution and then bonded together under 2000N pressure at 550°C for 10 hours. Later, the holes in the top wafer are covered with parafilm pieces in order to protect the nanochannels from dust.

Summary:
The fabrication procedure has been developed for repeatable and reliable fabrication of the nanometer-sized channels, sealed between two glass wafers.
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Figure 1:
Optical micrograph of fabricated channels with 200 nm particles floating in the water.

Figure 2:
AFM topography of a nanochannel.