

**Flowing Lattices of Bubbles as Tunable, Self-Assembled Diffraction Gratings:
Supplemental**

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Fabrication of optical devices using elastomeric materials such as PDMS can be problematic. Low aspect-ratio channels ($h/w < 0.3$) readily deform (sag or balloon) with the application of external or internal pressure.^[1] In order to avoid this problem, we took one of the two approaches: i) embedding a glass plate in the PDMS devices to provide rigid support, Figure S1-a.ii, and ii) redesigning the outlet channel with internal supports parallel to the direction of flow, Figure S1-a.iii. Both of these approaches provided support for the fluidic channels, and minimized channel-deflection under high internal pressure.

Figure S1-a.i depicts the results of bubbles flowing in a deformable channel – bubbles formed bilayer in the middle while they formed monolayer near the edge of the channel. Figures S1-a.ii and iii depict the results of bubbles flowing in channels that were supported by ii) an embedded glass plate, and iii) vertical supports in the channel.

Figure S1-b shows a schematic diagram describing the process we need to embed a glass support in PDMS parallel to the microfluidic channels. We fabricated the master of the mold for the fluidic channel using standard techniques of the preparation for microfluidic systems.^[2] The master was replicated in PDMS using standard replica-molding techniques. A layer of fluorosilane prevented adhesion between the PDMS mold and the PDMS replica. We spin-coated and cured a thin layer of PDMS ($\sim 200 \mu\text{m}$) on the elastomeric replica (again with fluorosilane to prevent adhesion between the two layers). We poured a second layer of PDMS (here there was no fluorosilane to prevent adhesion) and immediately placed a glass slide on top of the cured thin layer. The use of an elastomeric mold aids the release the rigid replica from the mold. If we use a rigid

Si/SU-8 master to mold the glass-embedded replica, the silicon master is very likely to crack upon separation from the replica.

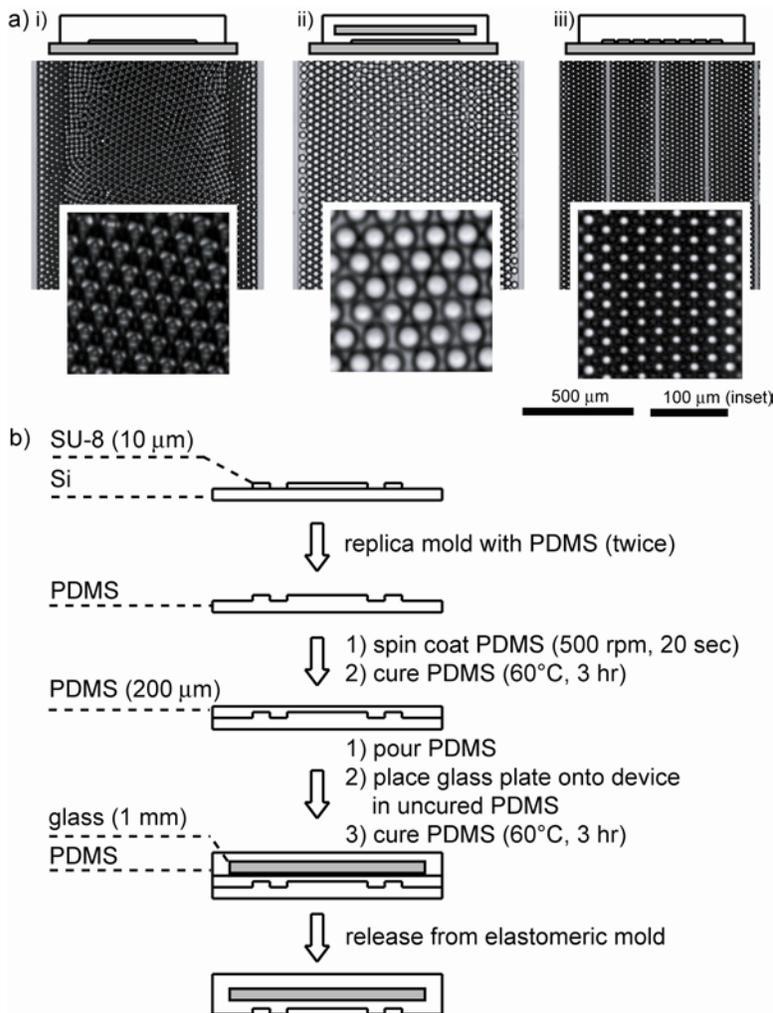


Figure S1. **a)** Optical microscope images of lattice of bubbles in i) 1-mm wide channel without support, ii) 1-mm wide channel with an embedded glass plate, and iii) arrays of 200- μm wide channels. The pictures in the insets show magnifications of the assembly of bubbles in the center of the channels. Deformable channels, (i), yield bilayers and monolayers of bubbles, in the middle and at the edge of the channel, respectively. Supported channels, (ii) and (iii), show uniform monolayers of bubbles that span the entire width of the channels. **b)** Scheme of the fabrication of a ‘rigid’ microfluidic channel by embedding glass into PDMS.

References

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