Distributed Colorimetric Interferometer for Mapping the Pressure Distribution in A Complex Microfluidics Network

Supporting Information

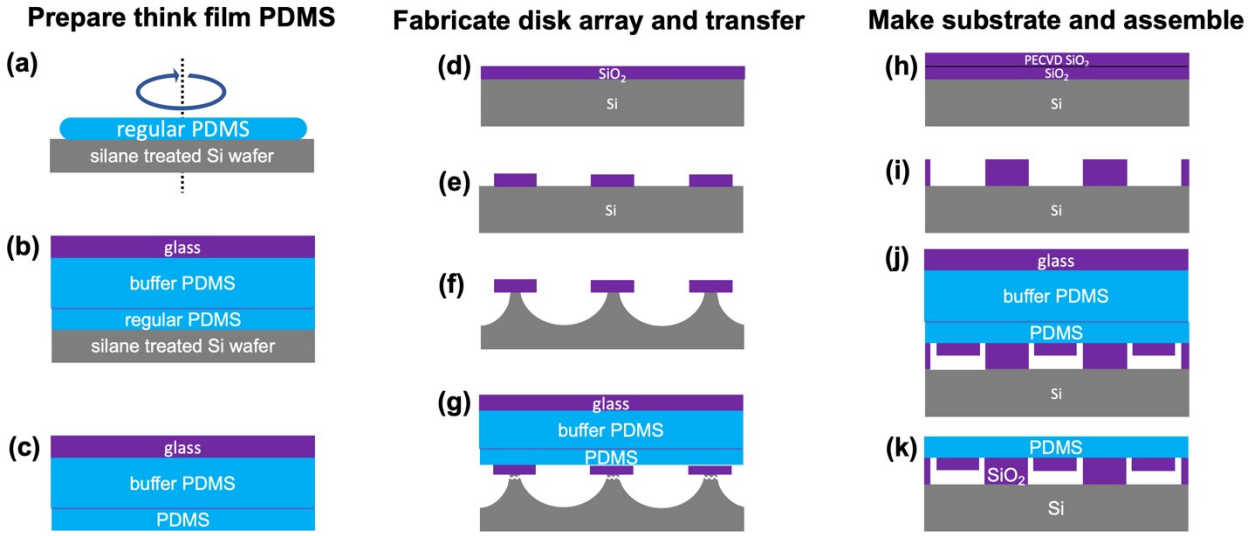

Figure S1. Fabrication process workflow for the colorimetric interferometry pressure-sensor. (a) A thin PDMS film is prepared by spin coating (4000 rpm, 5 min) and baking inside an oven at 65 ^{o}C until cured to achieve a final thickness of 6 µm. (b) Additional PDMS is poured onto the thin layer cured PDMS and covered with a glass slide. (c) After curing, glass and PDMS are peeled off the silicon wafer. This PDMS film is attached temporarily onto a hybrid glass-PDMS buffer. (d) A 1.56 µm thick silicon dioxide layer is thermally grown on a silicon wafer. (e) The silicon dioxide layer is patterned into a disk array. (f) The silicon substrate beneath is isotropically etched to form narrow anchors. (g) Silicon dioxide disks are then permanently bonded to the thin PDMS film through oxygen plasma treatment (80 W, 500 mT, 30 s) and oven baking (65 ^{o}C, 2 hours). After that, the chip is immersed into a mixed water/acetone (1:1 v/v ratio) ultrasonic bath to break the silicon anchors, a step that transfers the disk array onto the PDMS film. (h) A silicon substrate with 1.56 µm thermally-grown oxide goes through an extra oxide

deposition step using plasma-enhanced chemical vapor deposition (PECVD) to add an extra thickness of 550 nm, which is to define the initial air gap spacing. (i, j) An array of wells is etched out of this silicon wafer and bonded to the prior thin PDMS film to form optical cavities. (k) The hybrid buffer is then peeled off to finish the fabrication process.

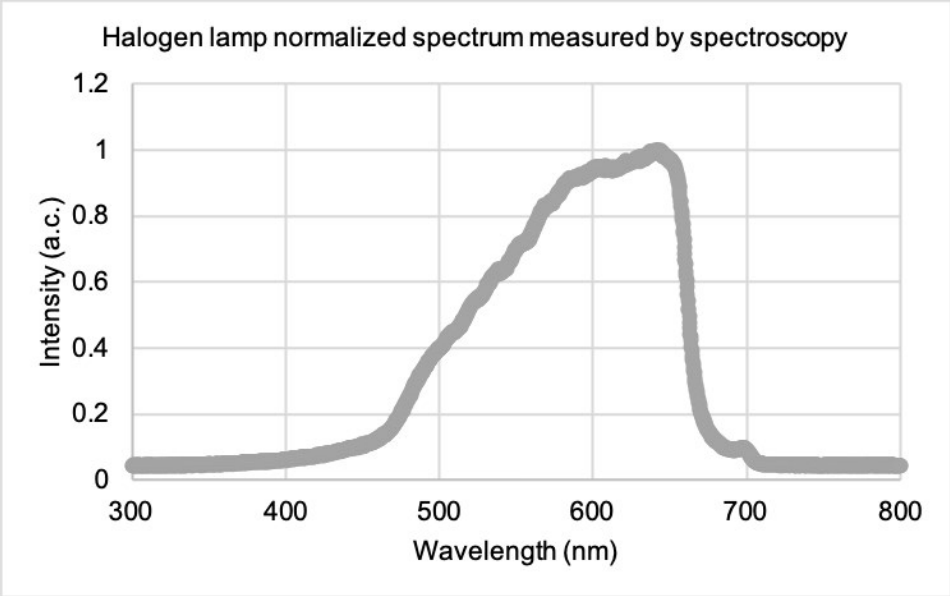

Figure S2. Illumination spectrum of the halogen lamp. The spectrum is measured by a commercial spectrometer (Ocean Optics HL-2000-HP) after warming-up the halogen lamp and operating at a fixed brightness setting for 5 min. All experiments were conducted under the same brightness setting.

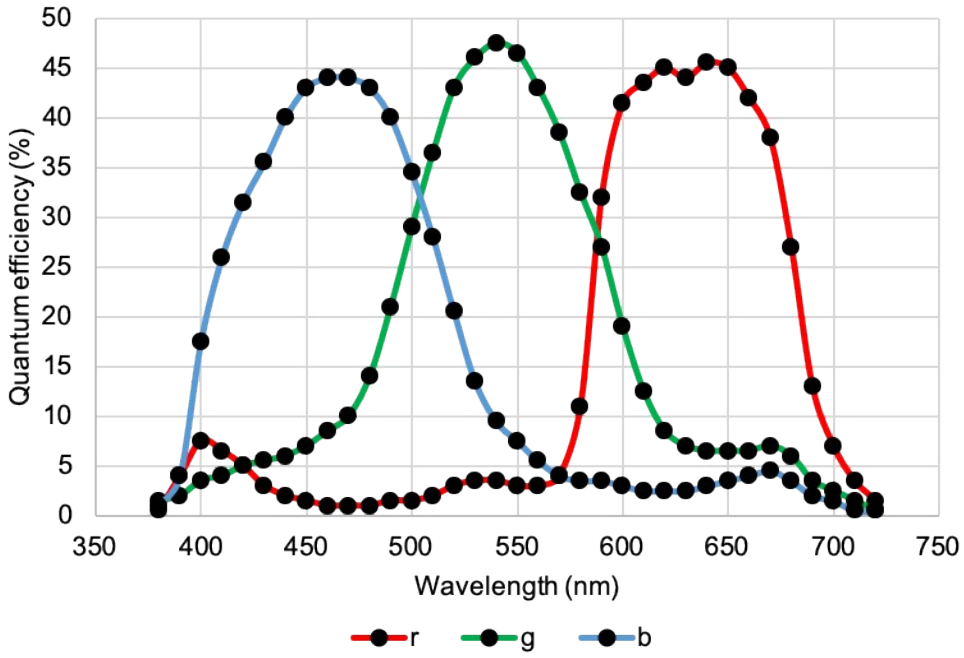

Figure S3. Camera sensor color sensitivity spectra. The camera sensor color sensitivity spectrum was extracted from the specification manual of Grasshopper GS3-U3-41C6C-C provided by the manufacturer.

Figure S4. Simulation of pressure distribution inside a microfluidic network. The flow direction is from left to right.

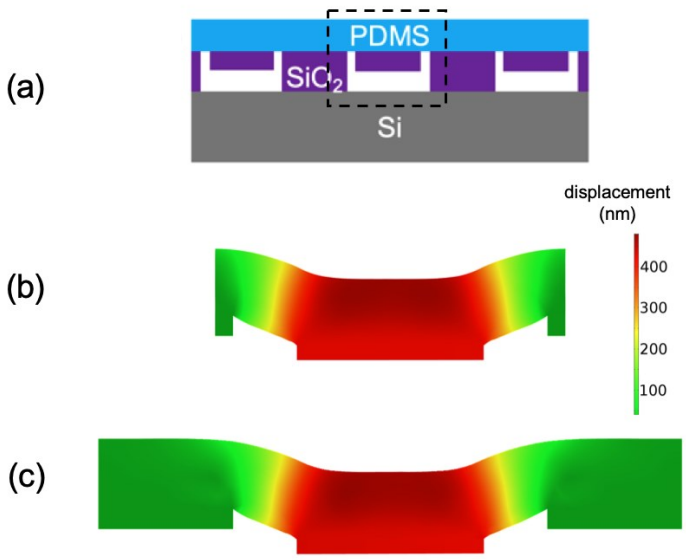

Figure S5. Simulation of PDMS thin film deformation under pressure. (a) Simulation is performed on one sensing spot assuming 5 psi pressure applied from top. (b) When sensing spots are designed with a 30 μm pitch, the deformation at the edge of each unit (42nm) is already one order smaller than the deformation at the center (476nm). (c) As the pitch is increased more, the mechanical interference will also diminish further. At a 50 μm pitch, there is almost no mechanical interference between units.