Supplementary Material (ESI) for Lab on a Chip

Tunable Two-Dimensional Liquid Gradient Refractive Index (L-GRIN) Lens for Variable Light Focusing

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1. Device Fabrication Procedure

The 2D L-GRIN lens was fabricated through the following procedure:

a. The pattern of the fluidic chamber was designed using AutoCAD software.

b. The pattern was transferred onto a photo-mask using a high-resolution laser writer, DWL66 (Heidelberg Instruments).

c. The mould for soft-lithography (thickness = 155 μm) was fabricated on a silicon wafer by Deep Reactive Ion Etching (DRIE).

d. The silicon mold was processed with 1H,1H,2H,2H-perfluorooctyl-trichlorosilane vapor (Sigma Aldrich) for reducing the surface adhesion to PDMS.

e. The PDMS device was made with Sylgard^{TM} 184 silicone elastomer base and curing agent (Dow Corning), which were mixed in a 10:1 weight ratio. The mixture was casted onto the silicon mould and cured at 65 ºC for 1 h.

f. Inlets and outlets were made by drilling, and polyethylene tubings (Becton Dickson) were inserted for the connection to syringe pumps (KDS 210, KD scientific).

g. In this experiment, the device includes a glass substrate sandwiched by two PDMS layers (a lens chamber and a dye chamber). The alignment of the two PDMS layers on opposite sides of the glass substrate was performed manually under a microscope.

2. 2D HS Curve fitting for CFD Simulated Results

For the ray-tracing simulation, a 2D HS curve fitting was performed on the CFD-simulated 2D refractive index profile. Fig. 1a shows an example of the refractive index profile obtained with CFD ($CaCl_2$ solution flow rate = 8.0 μl/min, DI water flow rate = 8.0 μl/min). The 2D HS curve-fitted result is shown in Fig. 1b. Fig. 1c is the refractive index difference between the CFD -simulated result and 2D HS curve fitting model. Fig. 1c suggests that the CFD simulated

refractive index profile can be well-fitted to a 2D HS profile.

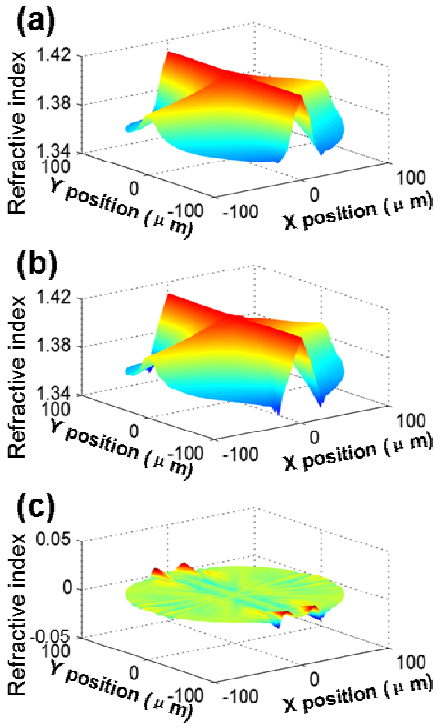

Fig. 1 2D HS Curve fitting for CFD Simulated Results. (a) The refractive index profile obtained with CFD ($CaCl_2$ solution flow rate = 8.0 µl/min, DI water flow rate = 8.0 µl/min). (b) 2D HS curve fitted refractive index profile. (c) The difference between (a) and (b)