3D fluidic lens shaping - A multiconvex hydrodynamically adjustable optofluidic microlens

Supplementary information

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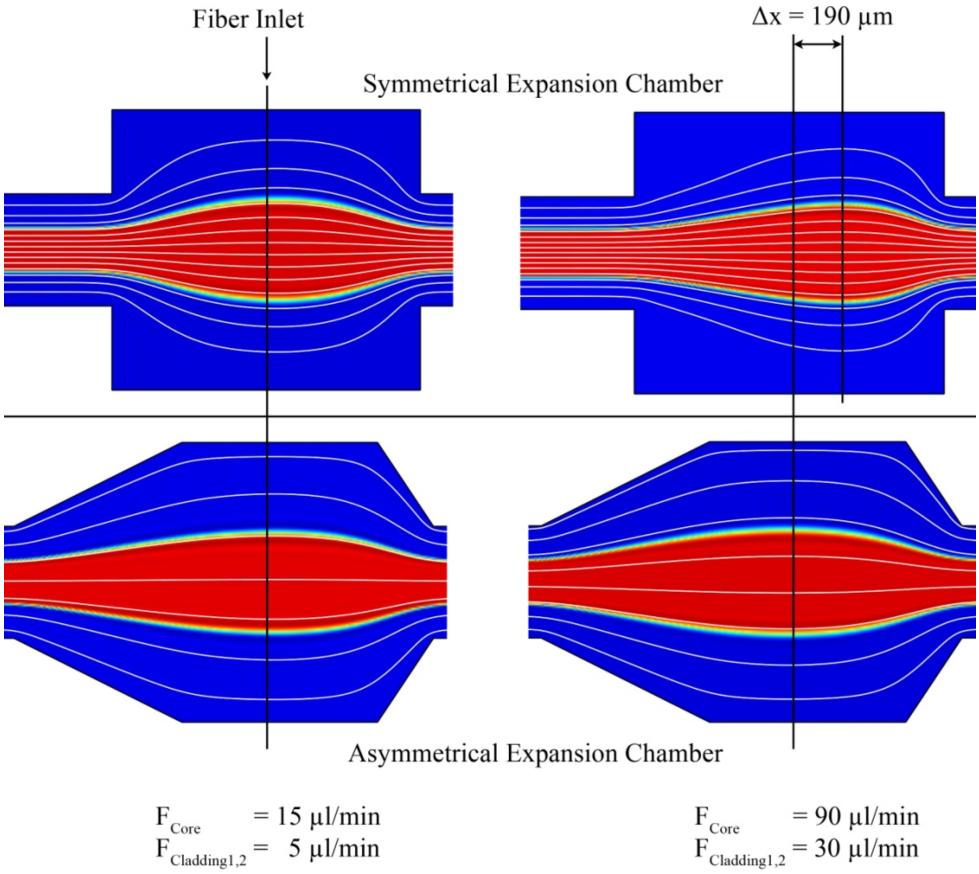

Fig. 1S Fluidic simulations of two expansion chamber designs at different flow rates. The symmetrical design shows good flow symmetry at low flow velocities. By increasing the flow rates from Core/Cladding = 15/5 µl/min to Core/Cladding = 90/30 µl/min the symmetrical chamber design shows two distinct disadvantages. The sample distribution is no longer symmetrical to the optical axis and secondly the optical axis is shifted to the outlet by 190 µm. Our presented design significantly decreases these effects by applying two asymmetrical slopes (30°, 60°).

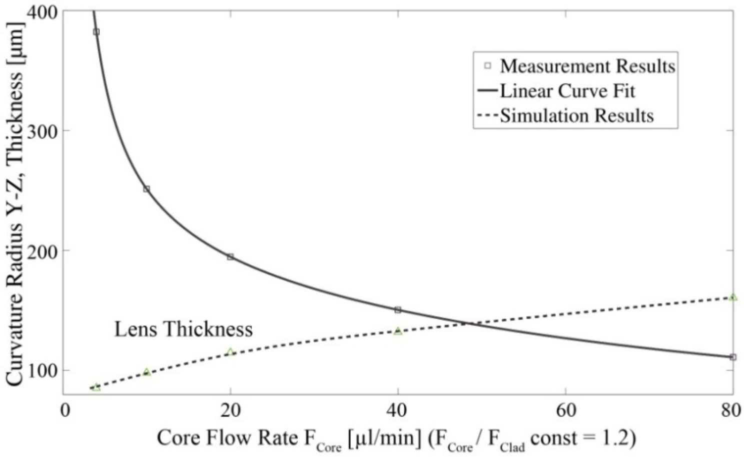

Fig. 2S Curvature radius of the liquid lens (Y-Z) as a function of the core flow rate. The core/cladding ratio is fixed thus the absolute flow rate values changes. Below F_{Core} = 5 µl/min the lens shape is slightly influenced by discontinuous pumping distortions; above F_{Core} = 70 µl/min the lens height decreases and the form misshapes to a non-cylindrical lens. The thickness of the lens increases nearly linear with increasing flow rates which influences the focal lengths of both lens curvatures.

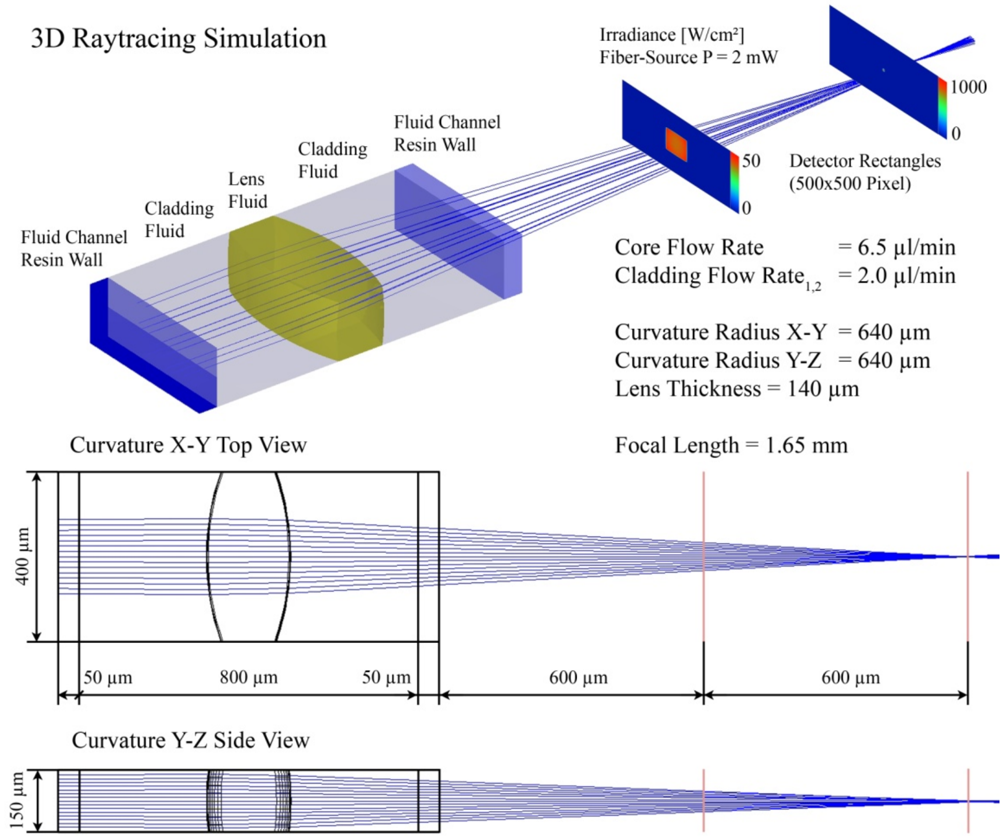

Fig. 3S 3D non-sequential raytracing simulations of the pre-calculated fluidic condition (F_{Core} = 6.5 µl/min, $F_{Cladding}$ = 2 µl/min) (ZEMAX). The curvature radius determined by the fluidic simulation are similar to each other ($r_{X,Y} = r_{Y,Z}$ = 640 µm). Therefore, it is possible to achieve a congruent focal length for lens shapes. The geometry of the iso-surface at n = 1.5 was used as lens surface. For better illustration of the focusing effect we chose a quasi-parallel source rays and increased the source diameter from d = 50 µm to d = 150 µm. In further redesigns and measurements it is advantageous to use a collinear laser source or fiber tips to collimate the incident laser beam.