

3D waveguide fabrication in thermoset polymer using nanosecond laser-induced bubble

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We have developed a microfabrication technique of a thermoset transparent polymer polydimethylsiloxane (PDMS), referred to as “microFLIB” : (microFabrication using Laser-Induced Bubble) [1]. In this process, the laser beam was focused inside the uncured liquid PDMS and was scanned both perpendicular and parallel to the laser beam axis to generate a 3D line of laser-induced bubbles. Since the shape of the bubbles is retained for a while, a 3D hollow microfluidics in the PDMS substrate can be created following the thermal curing of the uncured PDMS [2]. In this study, we applied microFLIB to degassed liquid PDMS. By using the degassed PDMS, the laser-induced bubbles collapse immediately following the laser irradiation, and the collapse will aggregate the thermally cured PDMS membranes which surrounded the bubbles and to form a dense structure in the laser focal point in the uncured PDMS as shown in Fig. 1(a).

The dense structure exhibited a refractive index change, compared to the surrounding uncured PDMS, and performs as a waveguide when scanning the laser beam to create a line of dense structures in the PDMS. As shown in Fig. 1(b, c), we successfully fabricated 3D waveguide inside the PDMS by introducing the focusing white light and HeNe laser on the structures.

In this presentation, we will demonstrate the waveguide fabrication using the microFLIB in detail and investigate the fundamental characteristics of the waveguide performance created in PDMS substrate.

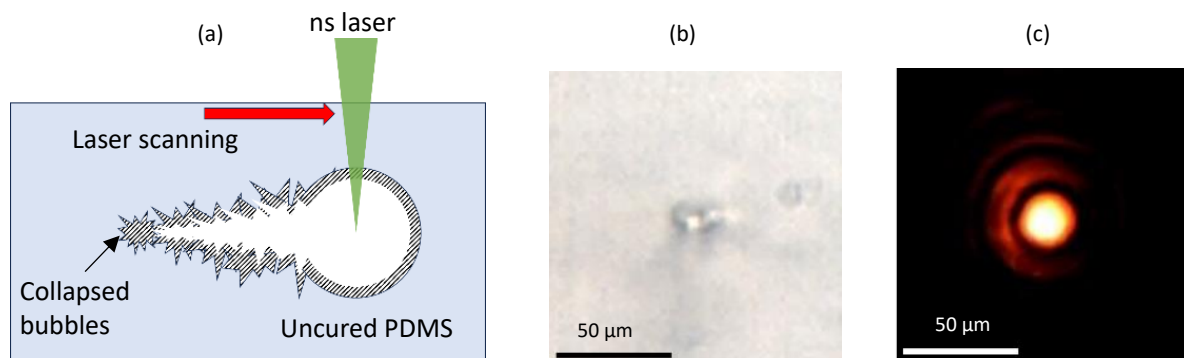


Figure 1: (a) Schematic diagram of waveguide fabrication in uncured PDMS. End facet of the fabricated waveguide when introducing (b) white light and (c) HeNe laser beam.

References:

- [1] T. Naruse, Y. Hanada, *Opt. Express*, 27(7), 9429 (2019).
- [2] Y. Toba, Y. Hanada, *Opt. Lett.*, 47(24), 6436 (2022).