Fabrication of Micro-lens Arrays Using CO_2-Assisted Embossing

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Abstract

Polymeric microlens arrays have been wildly used for focusing light on detectors and illumination in flat panel displays. There are many methods to fabricate microlens arrays such as photoresist reflow method, excimer laser ablation, gray scale photolithography, microjet fabrication and so on. They are either not accurate enough or expensive. We have developed an innovative method for fabrication of polymeric microlens by applying pressure on a polymer substrate placed on a mold with circular hole arrays as shown in Fig.1. CO_2 gas has been used as pressuring media and solvent in our present work. The process is advantageous for large-area imprinting.

Embossing temperature can be operated at only 75℃, well below the T_g of Poly(methyl methacrylate) (PMMA) substrate. Fig.2 is the result of fabrication the microlens arrays. There are 22500 microlens on the 5cm × 5cm substrate, the diameter of each lens is 100um. With increase in the CO_2 dissolving time, the center height of microlens is increases. Microlens with different focal length can be fabricated with different CO_2 dissolving time.

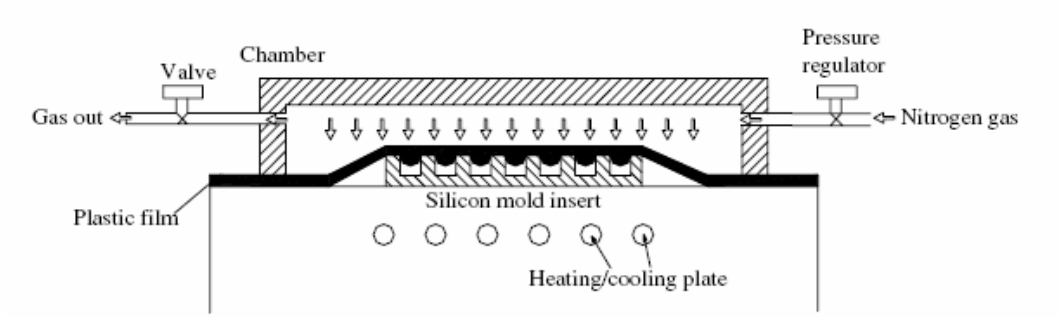


Fig.1 Schematic drawing of gas-assisted hot embossing process to fabricate microlens arrays.

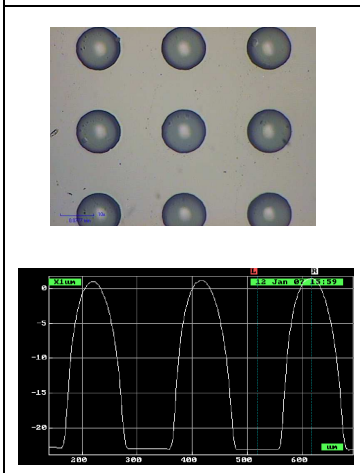
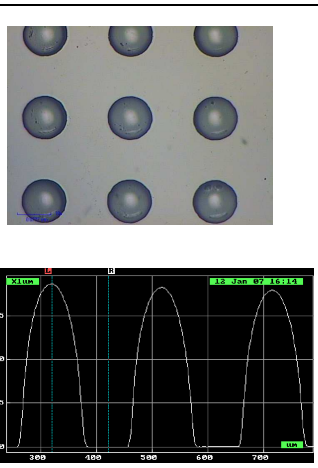
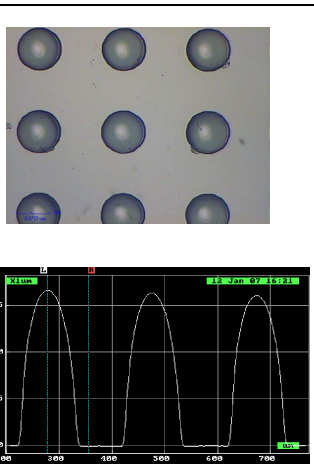
(a)	(b)	(c)
		
Height: 24.55 um	Height: 18.63 um	Height: 16.69 um

Fig.3 Microlens structures OM images and the center height measured with surface profiler (α-step) at 70 bar dissolving pressure, 10 bar imprint pressure. The temperature is 75℃. CO_2 dissolving times are (a)60min, (b) 40min and (c)20min.