Preparation of reflexite collimating film (RCF) by ink-jet technique with organic-inorganic hybrid precursor

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Keywords: organic-inorganic hybrid precursor, tetraethylorthosilicate, atomic force microscope, reflexite collimating film, ink-jet technology

Abstract

In this study, we prepared the multi-refraction film thin by ink-jet technique with sol-gel precursor. The precursors were prepared by using some transition metal alk-oxide and the tetraethylorthosilicate (TEOS) mixed separately with n-Butyl Alcohol and PVB (Poly(vinyl butyral)).The structure and morphology of the resulting films were investigated by atomic force microscope (AFM). It is shown that the shape of the pattern of the films would affect the refraction proportion.

1. Introduction

Reflexite Collimating Film (RCF) is an optical film used to condition the light output of transmissive backlit displays and allows the management of available light more effectively. RCF features precise prisms on one side and a micro-replicated, non-smooth surface on the other side. The benefits of using RCF include a brighter backlight module and increased battery life. And microlens can be use as the Reflexite Collimating Film. In later years, many fabrication ways have been explored to obtain refractive microlens arrays [1–5]. These methods include photolithographic methods [1] micro jet technique [2], ultraviolet curing of polymer [3], replica molding [4], and MEMS process [5] are all newly developed methods for the polymeric lenses. In this study, prepared the reflexite collimating film by with microlens and the precursors were prepared by sol-gel technique. And the precursors can also be used for the ink-jet technology. It becomes much easy for the pattern design though the ink-jet technology.

2. Experimental

. The equipment used is a drop-inject printer (Dimatix Materials Printer, DMP) with 16 nozzles in 254 μm spacing (100dpi). The nominal single drop volume is about 10 pico liter. Fluid temperature is adjustable from ambient to 70ºC for controlled jetting. Single and array of droplets were deposited on the x-y driven glass substrates and glass substrates coated with red organic dye. The shape and the contact angle of the drops are investigated by CCD camera. An organic-inorganic hybrid precursor was obtained by hydrolysis of tetraethylorthosilicate (TEOS) and some transition metal alk-oxide. They ratio of the some transition metal alk-oxide/TEOS are from 5wt% to 40 wt%. The precursors were prepared by mixing the materials with 50% volume fraction of and n-Butyl Alcohol: PVB (Poly (vinyl butyral)) = 20:1. The mixture was added 10 μl HCl per 20ml of TEOS and aged for 12 hours. After deposition, the specimen was baked at 200℃ for one 1h to remove excessive solvent. The shape and surface roughness of lenses have been measured by atomic force microscopy (AFM, Digital Instrument, NS3a-D3100).

3. Results and discussion

Sol-gel precursors were prepared by mixing TEOS and other additives. The viscosity of the inorganic-organic precursors were adjusted by adding a certain volume fraction of ethanol in the range of 5~12 cps. The table 1 show that the viscosity and the surface tension of the precursors.

Table 1 The Viscosity and surface tension

	5wt%	10wt%	20wt%	30wt%	40wt%
Viscosity(cps)	6.2	7.4	8.9	10	11.3
Surface Tension(N/m2)	29	30	33	35	37

The precursor with a higher viscosity usually tends to block the nozzle and cause the split of the drop. On the other hand, lower viscosity would cause the spread of the drop not to form spherical lens. Than, the refraction was controlled by the weight ratio of some transition metal alk-oxide /TEOS. The Fig. 1 (a) shows that, the reflexite collimating film for precursor which the weight ratio of transition metal alk-oxide /TEOS is 5wt% by dropping on the glass substrate . And (b) is the glass substrate.

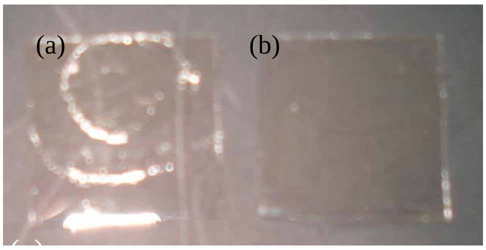

Fig. 1 The image of the Reflexite Collimating Film

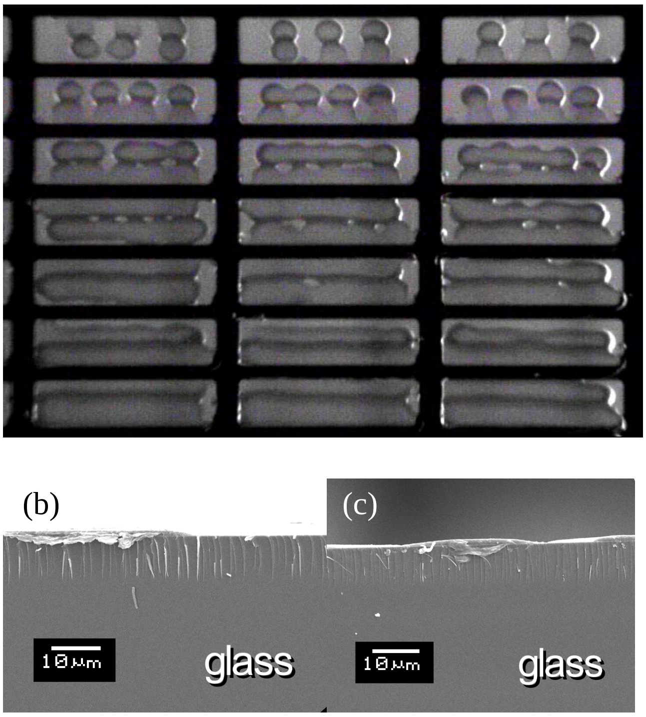

Fig. 2 (a) Array of the drop was made by controlled the space between the drops ; As the weight ratio of TIP/TEOS(b) 5wt% (c) 10% .

Fig.2 (a) shows the array of the drops deposited on the patterned glass substrate. Fig. (b), (c) show the the R.G.B glass substrates without/with the RCF. It was found that the R.G.B was well protected with RCF. Fig.2 (c) which is the R.G.B was detrimented without RCF. In addition, micro-replicated, non-smooth surface can be obtained.

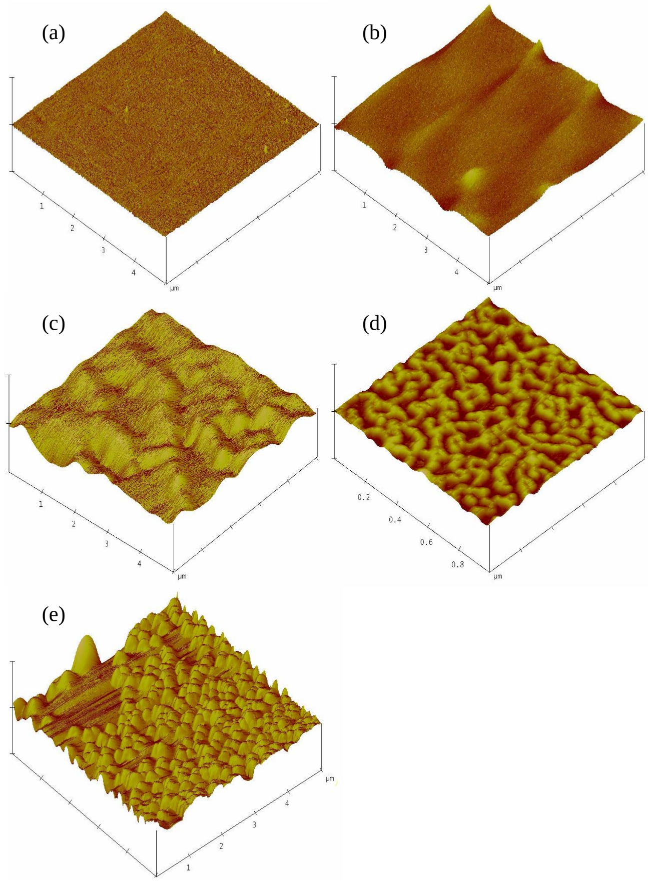

Fig 3. Surface morphology of the thin film by AFM. As the weight ratio of TIP/TEOS (a) 5wt% (b)10% (c)20% (b) 30% (e) 40%

The surface patterns of thin film surface were measured by AFM as shown in (Fig.3.) The results show that the surface roughness (Ra) is about 5.1nm(Fig.3(a))As the weight ratio of TIP/TEOS increased the surface roughness was increased. The (Ra) of 5wt% TIP/TEOS is 7.4nm, 10% is 70.6nm, 20% is 120.5nm, 30% is 170.1nm, and the 40% is 230.2nm. Eeah RCF shows unique pattern for different content of TIP/TEOS. This provides further app lication of RCF for surface modification of the device, such as antireflection and light focus.

4. Summary

Hybrid organic-inorganic materials derived from sol-gel stratify offers great opportunities for the development of physics, chemistry or biology in fun-ctional materials. It becomes possible for ink-jet technique with sol-gel precursor to control the patlerns of the thin films to obtain unique proportion. It shows high possiblility for the Preparation of reflexite collimating film

Acknowledgement

Financial support of this research by National Science Council, Taiwan, ROC, under the grant NSC 97-2221-E-036-004 is gratefully acknowledged

5. References

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