Fabrication of micro-lens array with ARS by using high hardness UV curable resin

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1. Introduction

Optical lens performance is hindered by reflections from the lens surface. Thus, there is a need for antireflection structures (ARSs) for optical lenses. However, previous UV curable resin can't be preventing from dust attaching on the lens surface [1]. In our previous sturdy, the antifouling propertied ARS was successfully fabricated by high hardness UV curable resin [2]. In this study, we suggested to add an antifouling properties and high hardness to micro-lens array with ARS by using this resin. Accordingly, it is possible to suppress the obstruction of concentrate light by dust on micro-lens array surface.

2. Fabrication process

Figure 1 shows the fabrication of a micro-lens array with an ARS by UV-NIL. Herein, we prepared the newly developed UV curable resin that have antifouling properties and high hardness. First, the resin was dropped on the film, and the reverse replica mold was set in a vacuum imprinting apparatus. Next, the sample was pressed at 40 MPa, held for 5 min, and exposed to UV light for 20 min. Finally, the film was released from the reverse replica mold and a micro-lens array with an ARS was obtained.

3. Result

Figure 2 shows the SEM images of the micro-lens array with the ARS. It can be seen that we successfully fabricated the micro-lens array with ARS. The ARS needle pitch and diameter measurements were 130 nm and 110 nm, respectively. Additionally, the height measurement of the ARS was more than 210 nm.
Figure 3 shows the reflectance of the micro-lens array and the micro-lens array with the ARS. According to Fig. 3, the reflection of the micro-lens array was 2.3 %, but it was suppressed to less than 0.8 % by the ARS. In addition, the water contact angle as the surface texture was increased from 118° to 147°, and the angular difference by 29°.

4. Conclusion

We can fabricate micro-lens array with ARS by using high hardness UV curable resin. Furthermore, the reflectance was suppressed, and the water contact angle was increased by the ARS. The micro-lens array with ARS fabricated using a high hardness UV curable resin can be expected to be used in antifouling properties lens of electronic devices.

Reference:

[1] Masato Nakamura, Ichiro Mano, Jun Taniguchi, "Fabrication of micro-lens array with antireflection structure" Microelectronic Engineering 211 (2019) 29–36
[2] Hikari Eto, Shin Hiwasa, Jun Taniguchi, "Tough and antifouling antireflection structures made by partial-filling ultraviolet nanoimprint lithography" Microelectronic Engineering 197 (2018) 33–38

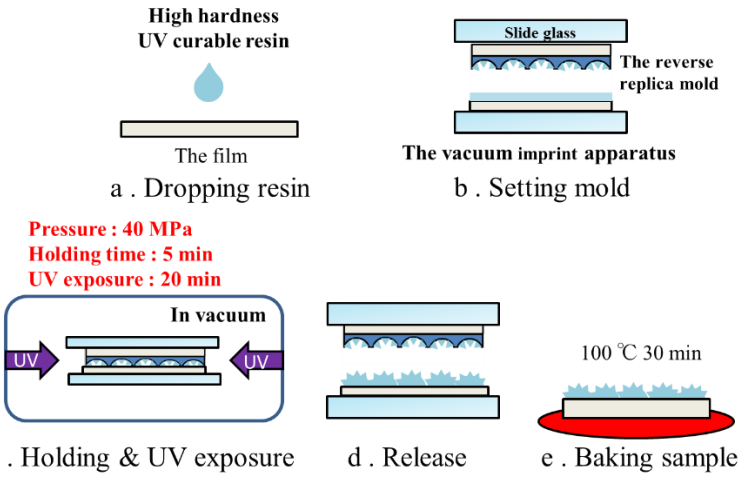

Figure 1. The fabrication process of the micro-lens array with ARS.

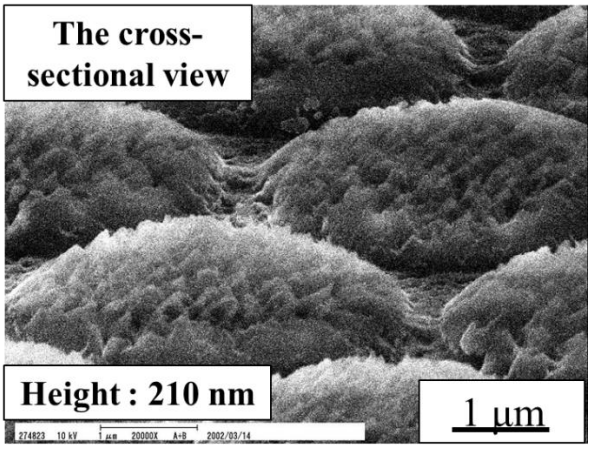

Figure 2. The SEM images of the ARS height of the micro-lens array with ARS.

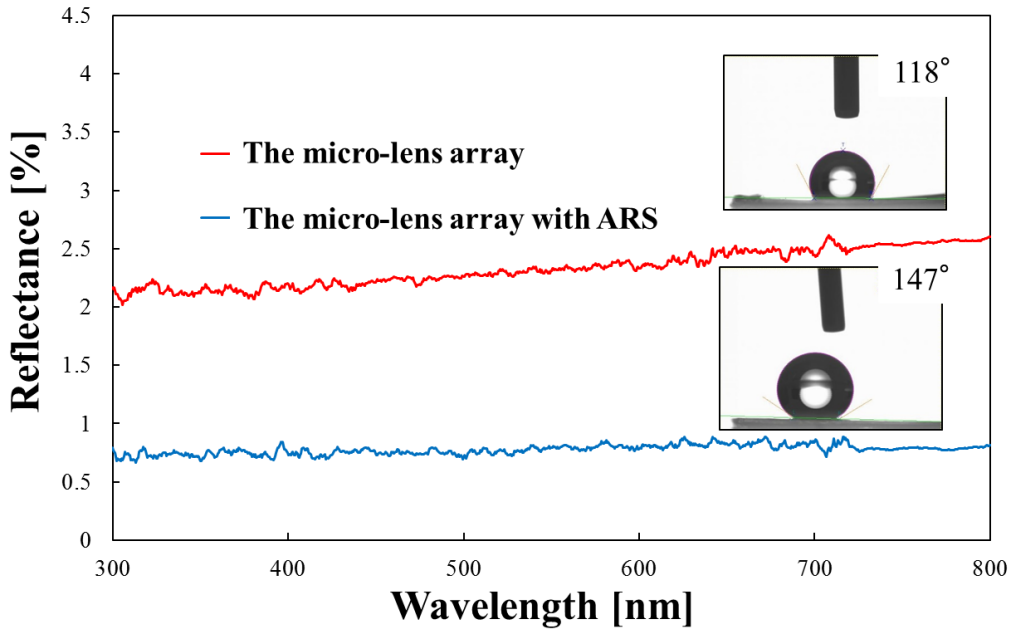

Figure 3. The reflectance and the water contact angle of the micro-lens array and the micro-lens array with the ARS.