Novel UV-NIL for opaque mold and substrate by use of UV triggered command cure resin

J. Tutui, H. Kawata, M. Yasuda and Y. Hirai
Osaka Prefecture University, Sakai city, Osaka 599-8531, Japan
kawata@pe.osakafu-u.ac.jp

1. Introduction

UV-NIL is very attractive technology for fabricating nano-patterns. In conventional UV-NIL process, an UV resist is cured by UV light through a mold. Therefore, the mold needs to be fabricated by a transparent material such as quartz. An opaque mold, such as Si and Ni, are unable to be used for UV-NIL. However, UV-NIL by use of Si or Ni molds is often desired because Si and Ni molds are widely used and their fabrication processes, including a replica mold fabrication, are extremely advanced.

In this report, we propose a novel UV-NIL by use of Si mold and substrate. In this process, UV triggered command cure resin is used as a new resist. The resin cure starts after a few minutes passing from an UV exposure. When the unique curing characteristic of this resin is used, the imprint patterning by Si mold can be carried out after the UV exposure.

2. Experimental

The process flow is shown in Fig. 1(a) ~ (c). The process time chart is also shown in Fig. 1(d). The commercial UV triggered command cure resin (SX-UV200 supplied by CEMEDINE Co. ltd) is used as the resist. The resin is coated by spin-coating. Since no thinner is used, the resist thickness becomes about 30 μm at 3000 rpm for 60 s. UV light is exposed to the coated resin for t_{exp}. A commercial UV-O_3 surface treatment device (PL-160, SEN LIGHTS Corp.) is used for the UV exposure, where a low pressure mercury lamp of 110 W is used. After the UV exposure, a Si mold is placed on the resin and the press is started. The time between the UV exposure termination and the press start and the press time are t_{set} and t_{press} respectively. The press pressure is fixed at 5 MPa. After the press termination, the Si mold is removed from the UV resin.

3. Results and Discussions

The process times are very important in this process. The exposure time, $t_{exp,}$, is fixed at 30 s. Enough resin curing is obtained after 10 min from the UV exposure termination. Then, t_{press} is fixed to 10 min. The value of t_{set} needs to be less than the resist cure start. First, the Si mold with 2 μm half-pitch LS pattern is used. Figures 2 show both the new UV resin pattern for t_{set}=3 min and PMMA patterns. Although good LS pattern can be obtained for the new UV resin, the pattern shape is slightly worse than the PMMA one. Therefore, t_{set} is shortened to 2 min. Figures 3 show the new UV resin pattern for the top and cross section views when a Si mold with submicron LS pattern is used. It is clear that the space pattern with 0.18 μm width can be successively fabricated.

The results for the thin new UV resist will be also shown.

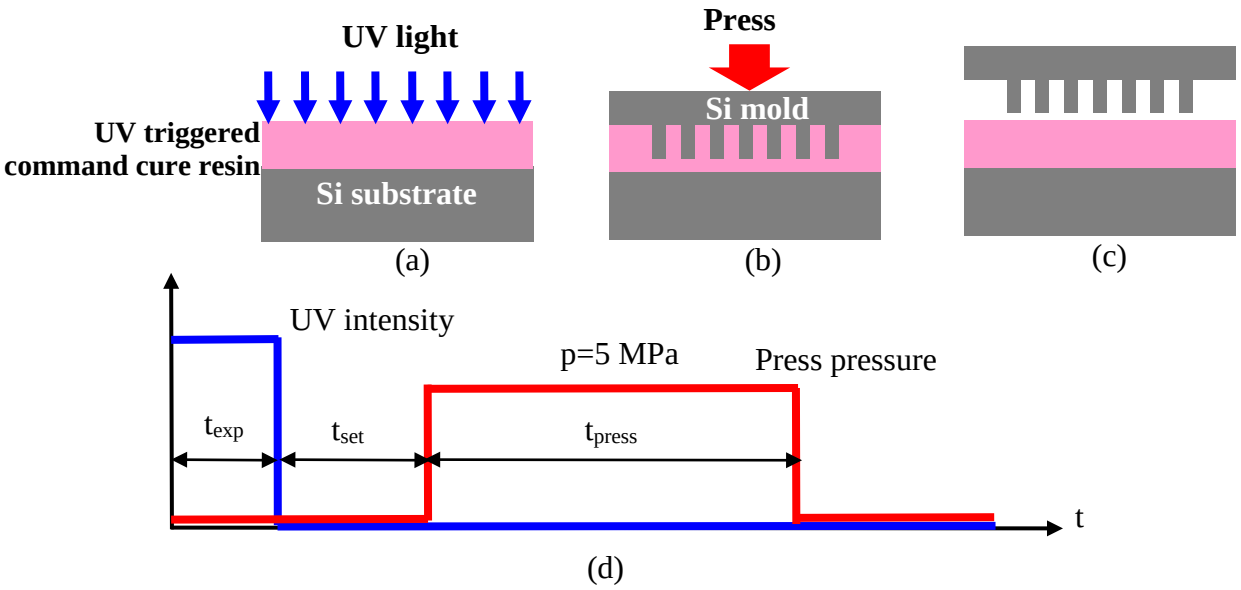
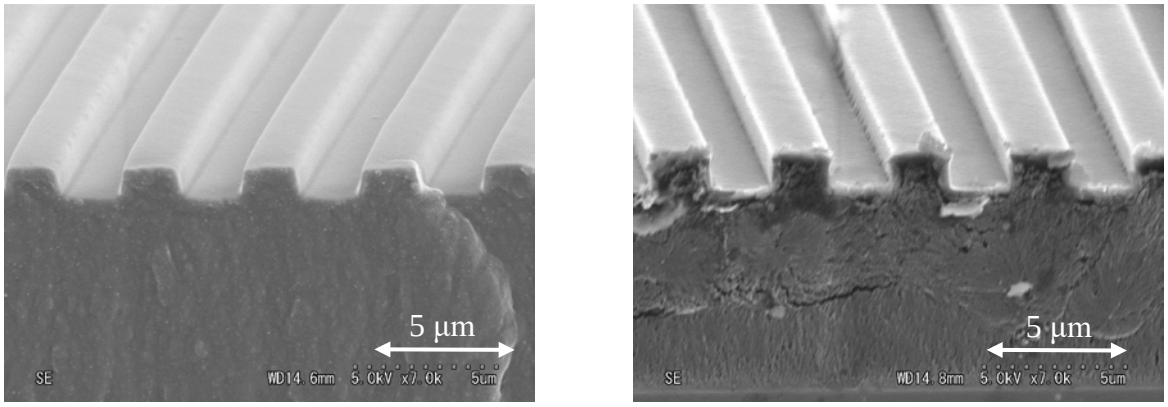
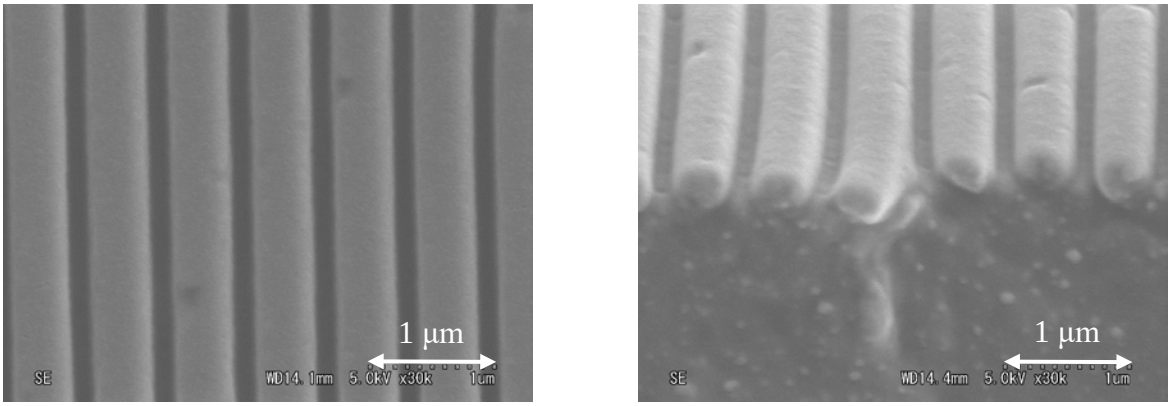


Fig. 1 Process flow ((a)~(c)) and process time chart (d).



(a) (b)

Fig. 2 Fabricated resist patterns by Si mold with micron size LS pattern, (a) new UV resin pattern and (b) PMMA pattern by conventional T-NIL



(a) (b)

Fig. 3 Fabricated new UV resin pattern by Si mold with submicron size LS pattern, (a) top view and (b) cross section view.