

Durability Evaluation of Antisticking Layer by Step and Repeat UV nanoimprinting

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Nanoimprint lithography (NIL) has a great potential to fabricate the nanostructure devices with a high resolution, a high throughput, and a low cost. The nanoimprint mold is usually coated with an antisticking layer because the mold is in direct contact with the replication material. The durability of the antisticking layer is one of the important factors to mass-produce the devices by NIL. To examine the durability of the antisticking layer in UV nanoimprinting, we made apparatus for step and repeat UV nanoimprinting as shown in Fig. 1. This system consists of spin-coater, heating-plate, cooling-plate, and UV nanoimprinting system. In addition, the 6 inch wafer is automating transported and the adhesion force between the mold and UV curable resin can be measured by the high-sensitivity load cell. We carried out step and repeat UV nanoimprinting and measured the adhesion force between the mold and UV curable resin by this system.

We used the 1 cm² flat quartz substrate coated with fluorinated self-assembled monolayer (OPTOOL DSX; Daikin Industries)¹⁾ as a mold. The 81 times, which means 9×9 chips, repeated UV nanoimprinting was carried out on a 6 inch wafer in this case. NIAC2310 (Daicel Chemical Industries) was used as the UV curable resin. The nanoimprinting pressure and UV (100 mW/cm² at 365 nm) irradiation time were 5 MPa and 5 sec, respectively. We obtained the graph from the voltage of the load cell as shown in Fig. 2, which is a relationship between the number of imprinting and voltage of the load cell. The adhesion force when the mold was separated from the resin is observed in this graph. In this experiment, 5 V equaled to 100 N. We calculated the averages of the adhesion forces from 1st to 9th, from 100th to 109th, from 298th to 306th, from 397th to 405th, and from 595th to 603th, as shown in Fig. 3. We confirmed from the measurement result that the averages of the adhesion forces increased by repeated UV nanoimprinting over 100 times.

We will demonstrate the durability evaluation of the antisticking layer over 10000 times step and repeat UV NIL and discuss the mechanism of durability degradation.

1) Y. Hirai, et al.: J. Photopolym. Sci. Technol., **14** (2001) 457

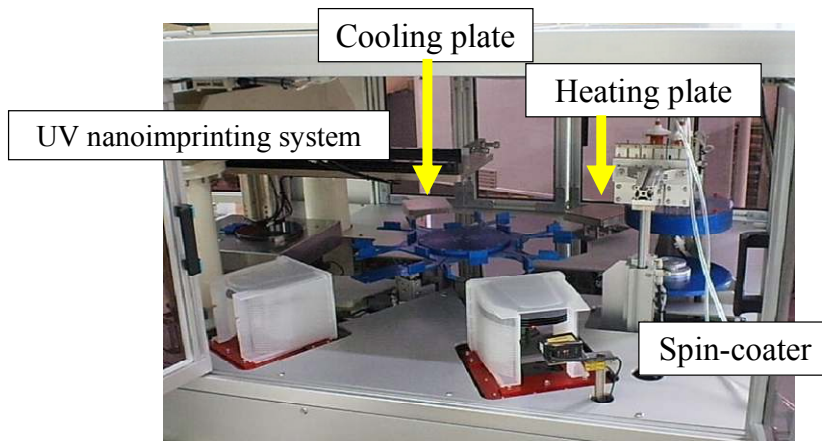


Figure 1. Photograph of step and repeat UV nanoimprinting system.

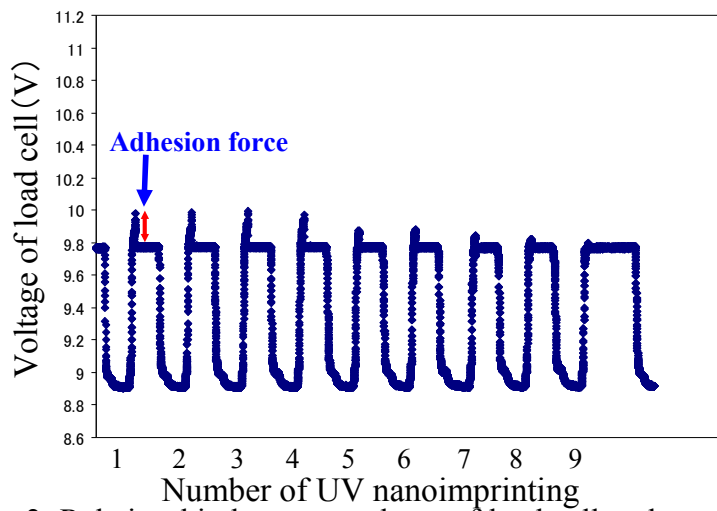


Figure 2. Relationship between voltage of load cell and number of UV nanoimprinting.

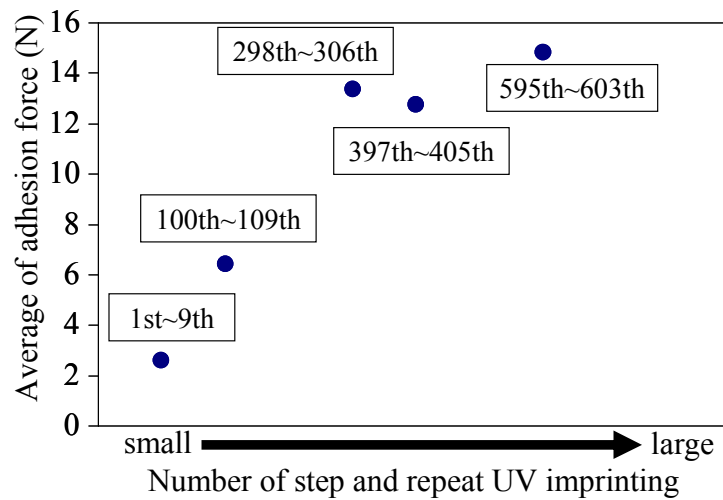


Figure 3. Relationship between average of adhesion force and number of UV nanoimprinting