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# Fabrication of 3-dimensional structure by nanoimprint process

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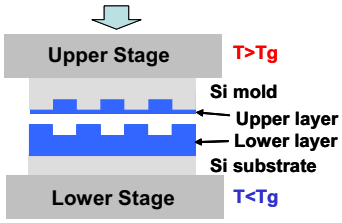
## 1. Introduction

Nanoimprint lithography (NIL) [1,2] is expected to fabricate advanced fine and integrated electron devices below 20 nm nodes because of it's superiors resolution down to single nanometer and cost-effective performance. Furthermore, the NIL has advanced capabilities than the conventional lithography such as EUV or EB lithography. One of them is continuous production of thin films by role to role imprint[3,4], which is expected to fabricate flexible organic electric devices or optical films for large display devices. On the other hand, fabrication of 3-dimensional structured has been proposed by reversal nanoimprint[5], which is effective approach to obtain 3-D structure in simple way. Also, hybrid imprint has been proposed to fabricate micro-nano mixed structures[6].

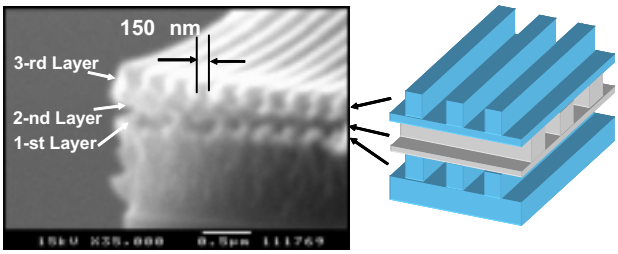
In this paper, we demonstrate novel fabrication based on reversal nanoimprint and hybrid imprint.

## 2. Stacked 3-D structure by Reversal NIL[7,8]

Fabrication of multi-layered nano-channel using PMMA is demonstrated by the reversal imprint lithography as shown in Fig.1. To avoid the deformation of the lower layer in the transfer mode, the temperature of the substrate is kept below the Tg of the polymer by cooling the lower stage[7], where the substrate is held on.




a) Schematic diagram of the




b) Experimental result

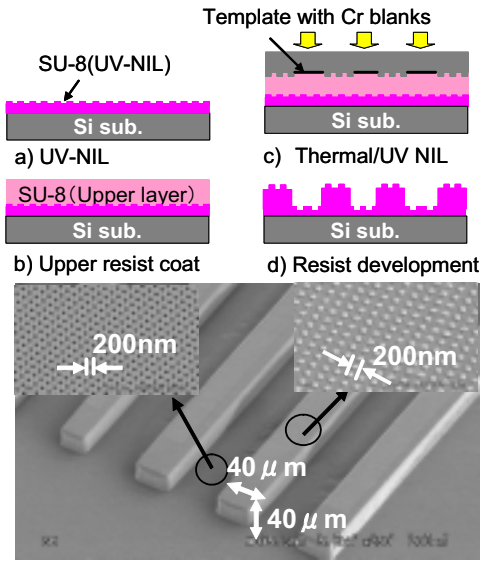
Fig. 1. Stacked PMMA 3-dimensional structure by thermally controlled reversal NIL.

Controlling the stage temperature of the mold and substrate, the temperatures of the upper and the lower layered polymers are kept to be over and below the Tg. Using this process, nano channels having 150nm feature size grooves are stacked on the lower layer without depression of the lower layers. We believe this process is promising technology to fabricate multi-layered nano channels for advanced nano fluid devices or nano optical elements in the simple way and ultra low cost.

## 3. Micro-nano mixed structure by Hybrid NIL[6]

Thermal and UV hybrid nanoimprint process is demonstrated to fabricate micro and nano mixed structures as shown in Fig.2. Using thick SU-8 resist, 200 nm dots and holes on micro gratings, which have 40 μm in height and 40 μm in width, are successfully demonstrated without using deep dry etching process or mixed and matching lithography processes.

We believe that the proposed hybrid nanoimprint process is easy and cost-effective method to obtain deep/micro and shallow/nano mixture structure for advanced optical elements or micro fluid devices.




e)Experimental result

Fig. 2. Fabrication of micro-nano mixed structure by advanced thermal-UV hybrid NIL.

## 3. Conclusions

Novel 3-dimensional structures are demonstrated by advanced NIL process such as reversal nanoimprint and hybrid nanoimprint. These processes would be effective to obtain advanced structure for nano bio devices or nano optical elements.

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