A-13

Fabrication of 70nm-sized metal patterns on flexible PET Film using nanoimprint lithography

Heon Lee*, Jong-Hwa Lee
Dept. Mater. Sci. & Eng, Korea Univ. 5-1 Anam-dong, Seounguk-gu, Seoul, Korea
Phone: +82-2-3290-3284, E-mail: heonlee@korea.ac.kr

Abstract

Nano-sized metal patterns were successfully fabricated on flexible PET substrate using nanoimprint lithography. 70nm line and space PMMA resist pattern was formed on PET substrate without residual layer by "partial filling effect' and 20nm thin Cr metal layer was deposited by e-beam evaporation. Then, PMMA resist was selectively removed by acetone and 70nm narrow Cr pattern was formed.

1. Objectives and Background

The fabrication of micro to nano-sized patterns on flexible polymer substrates such as PET films has been important for organic electronic devices, biomedical devices and flexible displays[1, 2]. However, the conventional photolithography process cannot be used for patterning on polymer substrates due to the reaction with organic solvents, which are inevitably used in photolithography. A new patterning technology has to be developed and nanoimprint lithography (NIL) is one of the most promising patterning technology since it can be effectively used to fabricate the nano-scale patterns on flexible polymer substrates with high throughput, simple process and low cost[3, 4]. Moreover, the use of organic solvents, which reacts to PET substrate is completely unnecessary in the fabrication.

2. Results

In this study, as shown in Fig.1, 3wt% poly-methylmethacrylate (PMMA) resin is spin-coated over a PET film substrate which is a flexible polymer material.

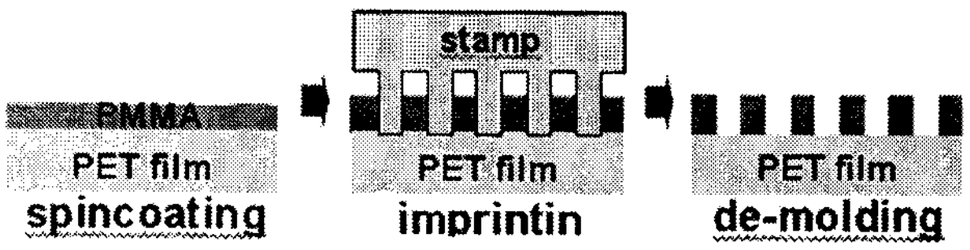

Figure 1. Schematic diagram of zero residue imprinting process on PET substrate.

After that, a template with nanometer scale surface protrusion patterns was imprinted in order to form the as narrow as 70nm narrow PMMA patterns with zero residual layer. Fig. 2-a and b shows SEM micrographs of imprint template, containing 70nm-narrow line patterns and imprinted PMMA pattern which has mirror image of template, respectively.

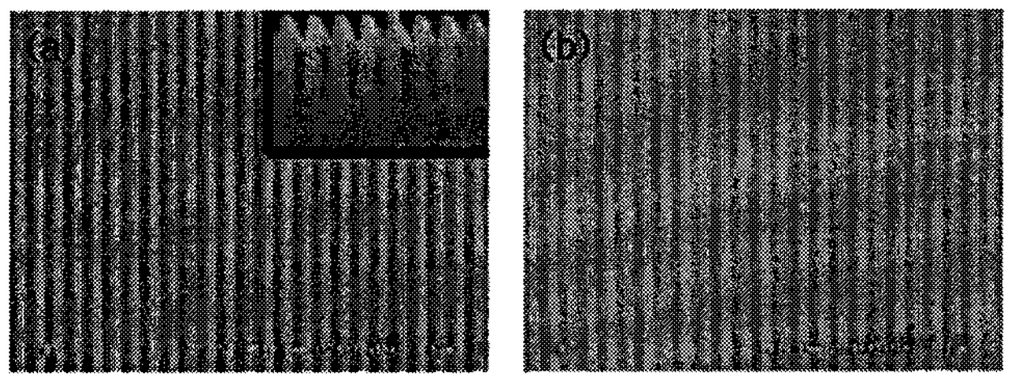

Figure 2. SEM images of (a) template and (b) imprinted pattern.

After imprinting, 20nm thin Cr layer is deposited by e-beam evaporation and PMMA resist can be selectively removed by acetone solution. As a result, 70nm line and space Cr patterns were successfully formed on flexible PET substrate. SEM micrograph of Cr pattern on flexible PET film after lift-off process and its AFM analysis are shown in Fig. 3-a and Fig. 3-b.

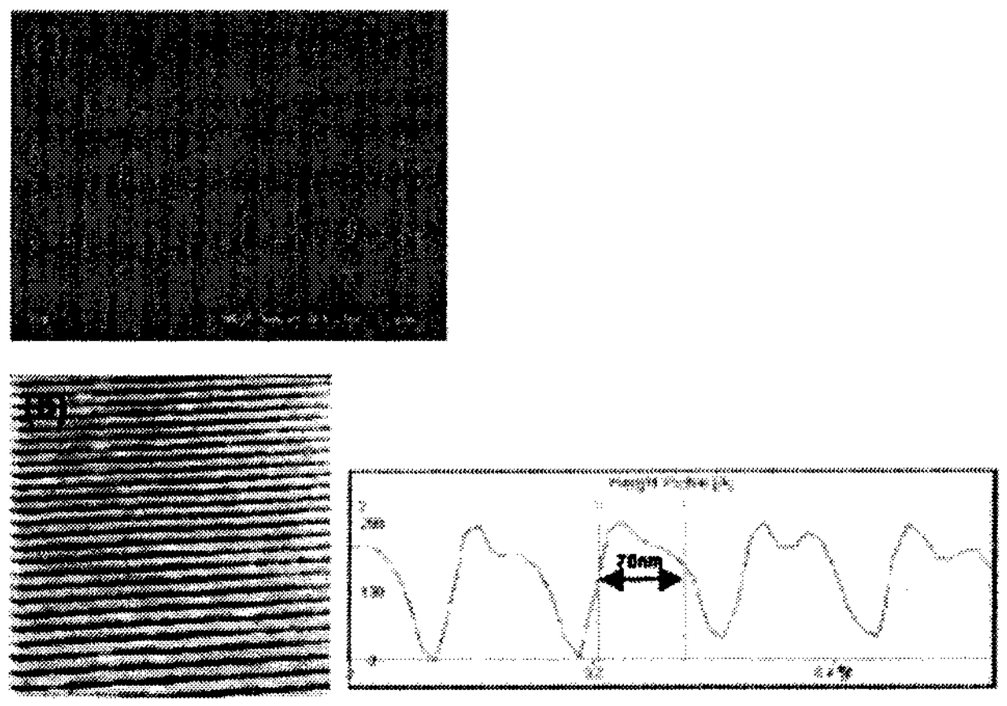

Figure 3. (a) SEM image of Cr pattern on PET film after lift-off and (b) AFM analysis of Cr pattern on PET film.

3. Impact

Fabrication of nanometer sized resist patterns on flexible PET substrate is extremely difficult. Fabrication of the same sized metal patterns on the same substrate is even more difficult. In this study, successful fabrication of 70nm narrow Cr metal patterns over the large area was demonstrated using nanoimprint lithography.

4. Acknowledgements

This research was supported by a Grant from the Center for Nano-scale Mechatronics and Manufacturing, one of the 21st Century Frontier Research Programs, which are supported by the Ministry of Science and Technology, Korea.

5. References

[1] M.C. McAlpine, R.S. Friedman, C.M. Lieber, NanoLetters 3 (2003) 443.
[2] Heon Lee, Sunghoon Hong, Kiyeon Yang, Kyungwoo Choi, Appl. Phys. Lett. 88, 143112 (2006)
[3] Stephen Y. Chou, Peter R. Krauss, Microelectronic Engineering 35 (1997) 237-240
[4] Heon Lee, Gun-Young Jung, Microelectronic Engineering 77 (2005) 42-47