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

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The fabrication of micro to nano-sized patterns on flexible polymer substrates has been important for organic electronic devices, biomedical devices and flexible displays[1, 2]. However, the conventional photolithography 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 is completely unnecessary in the fabrication.

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. After that, a template with surface protrusion patterns was imprinted in order to form the as narrow as 70nm PMMA patterns with zero residual layer. Since the thermoplastic polymer resin can become sufficiently fluidic and fill the nano-scale cavity when it is heated over glass temperature and during the imprinting process. After imprinting, the temperature drops below the glass transition temperature (T_g) and polymer patterns with zero residual layer are formed on the flexible PET substrate. Then, 20nm of Cr layer is deposited by e-beam evaporation and PMMA patterns can be removed by lift-off process with acetone. As a result, 70nm narrow Cr lines was successfully formed on flexible PET substrate. Fig.2-a to -c shows SEM microgragh of imprint template, containing 70nm-narrow line patterns, SEM microgragh of imprinted PMMA pattern which has mirror image of template and lifted off Cr metal line patterns on flexible PET substrate, identical to imprint template, respectively.

References

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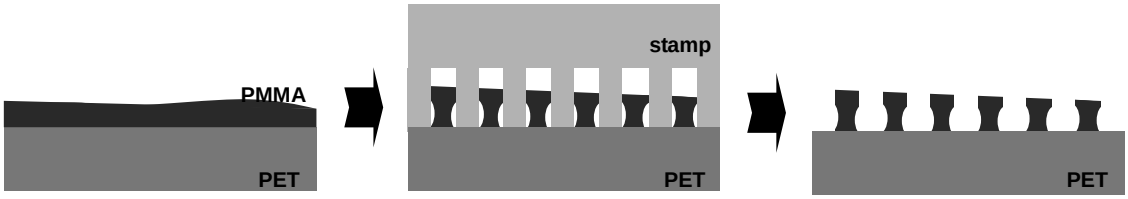

Fig. 1 Schematic diagram of zero residue imprinting process on PET substrate

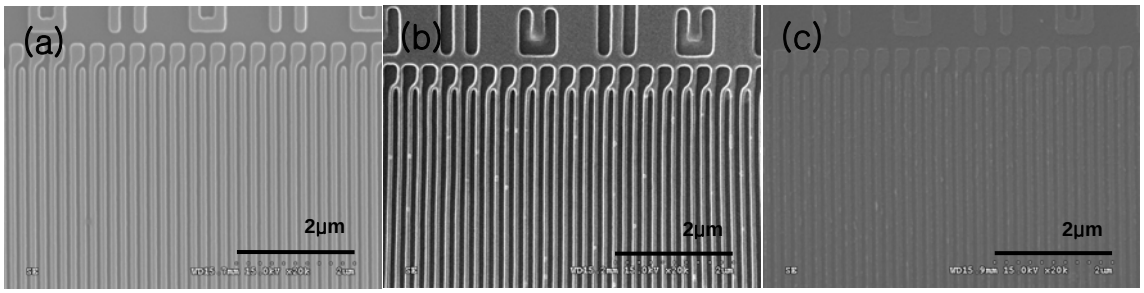

Fig. 2 SEM images of (a) stamp (b) imprinted pattern and (c) Cr pattern on PET after lift-off