

論文の内容の要旨
Abstract of Dissertation

論文題目 Fabrication of 3D Micro Structures on Cylindrical Substrates and Its Application for Roll
Contact Printing
(円筒形基板上の三次元マイクロ構造物の製作とロールコンタクトプリンティングへの応用)

氏 名 朴 鍾湊
Name of Author PARK, Jongho

(本文)(Abstract)

The purpose of this research is to develop the fabrication technique of micro structures on cylindrical substrates with localized optical softlithography. In addition, PDMS roller stamps were replicated utilizing the micro structures on concave substrates as the mold and roll contact printing was performed as its application.

Micro structuring on cylindrical substrates such as convex and concave substrates has not been fully established yet, although several fabrication methods, such as laser direct writing and modified photolithography, have been proposed and researched. However, those techniques require expensive equipment or complex processes in the fabrication. To overcome those drawbacks, localized optical softlithography using flexible photomasks were developed in this work.

Firstly, SU-8 micro structures were fabricated on convex substrates using film type SU-8 photoresists whose thickness is 25 and 50 μm , and PDMS flexible photomasks. Rotational UV exposure with the slit shadow mask was introduced to prevent unwanted exposures and pattern distortions. As a result, the micro structure which has around 15 μm line widths and the aspect ratio over 2.6 was fabricated on a convex substrate. Moreover, experimental parameters for localized optical softlithography were investigated and established for further applications.

Next, the fabrication of micro structures on concave substrates was also performed using flexible photomasks. Thus, SU-8 micro structures on concave substrates were successfully fabricated. In addition, the tilting structures were confirmed due to the vertical UV exposure method with the concave shape of a substrate. Finally, SU-8 structures with 2.5 μm line width and high aspect ratio over 7.9 were fabricated on a concave substrate.

Based on these novel 3D structuring technology, The PDMS roller stamps was fabricated using SU-8 structures as a mold and the roll contact printing was performed as the application of fabricated PDMS roller stamps. Roll contact printing was performed using two custom-designed stages for flat and

cylindrical substrates. As a result, it was confirmed that the roller stamps can be utilized as the industrial application for roll-to-roll microcontact printing.

Through this research, novel fabrication techniques for 3D micro structures on cylindrical substrates and PDMS roller stamps have been developed. In addition, the roll contact printing were proposed and demonstrated as the potential applications for industrial roll contact printing process. Furthermore, this technique can provide various sized roller stamps with various micro patterns for roll contact printing as well.