

# Roll-to-roll Nanoimprint Lithography on Flexible Plastic Substrate

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Nanoimprint lithography (NIL) is considered as one of the most promising and competitive technologies for high throughput and low cost nanopatterning. However, the current process and throughput in NIL (~10 min or longer per Si wafer) is still far from meeting the demands of many practical applications, especially in the area of organic electronics and biotechnologies. To meet these demands, faster and more economical fabrication method is necessary. A continuous roll-to-roll nanoimprint technique can provide a solution for high-speed large-area nanoscale patterning with greatly improved throughput; furthermore, it can overcome the challenges faced by conventional NIL in maintaining pressure uniformity and successful demolding in large area printing.

In this work, we present true continuous imprinting of nanoscale structures (70 nm and 300nm linewidth gratings) on a flexible plastic web substrate. Our new process used a flexible and non-sticking fluoropolymer mold fixed to a roller. We demonstrated continuous nanoimprinting by using low viscosity and fast thermal curable PDMS [1] and a liquid UV curable epoxysilicone resist [2] coated on the plastic web substrate. Liquid resist precursor can quickly fill into the mold cavity. Thus, the imprinting throughput, i.e., the web speed, mainly depends on the curing time of the resists, which is within a few seconds and could be further reduced by adjusting resist formulation and the power of the curing systems. We will discuss in detail the material requirement that made this process successful and also suggest a number of potential applications.

[1] C. P.-Hernandez, J.-S. Kim, L. J. Guo, and P.-F. Fu, *Adv. Mater.* 2007, in press.

[2] X. Cheng, L. J. Guo and P.-F. Fu, *Adv. Mat.*, 17, 1419-1424, 2005.

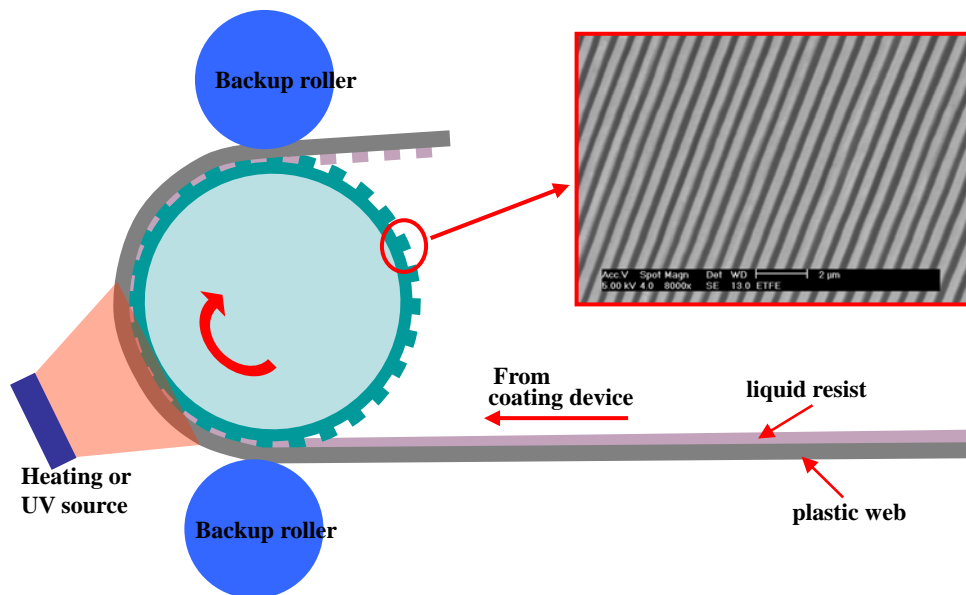


Fig. 1 Schematics of roll-to-roll nanoimprint lithography process. A flexible fluoropolymer mold (SEM picture shown on the right) is wrapped around a roller. The imprinting resist, a low-viscosity precursor liquid is coated on a flexible plastic web and is cured by heating or UV source during imprinting.

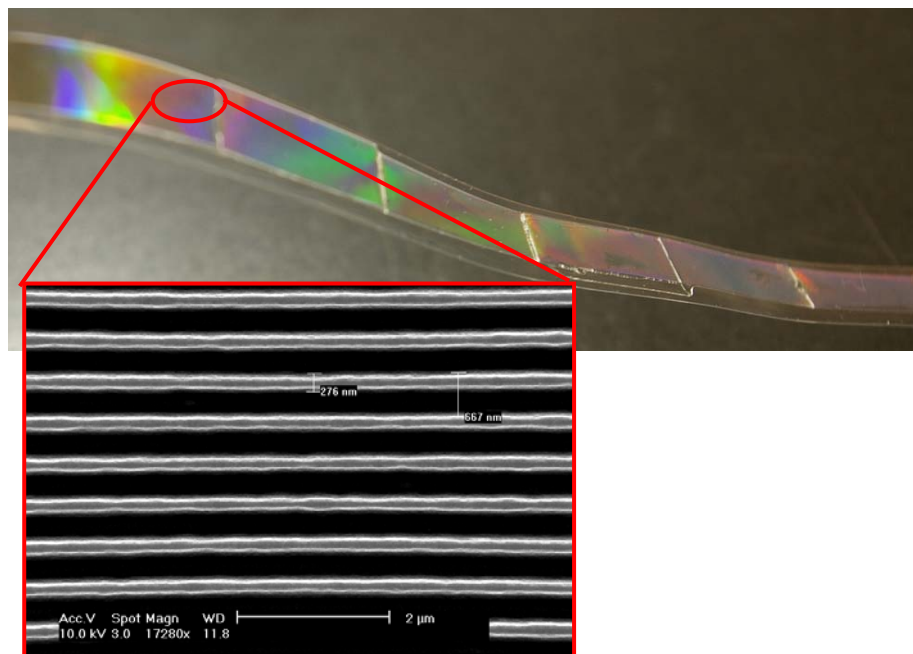


Fig. 2 Photograph of 300 nm linewidth grating structures (shown in the SEM picture) imprinted on the plastic substrate exhibiting strong light diffraction.