High-Speed, Roll-to-Roll Nanoimprint Lithography (R2RNIL) on Flexible Plastic Substrate

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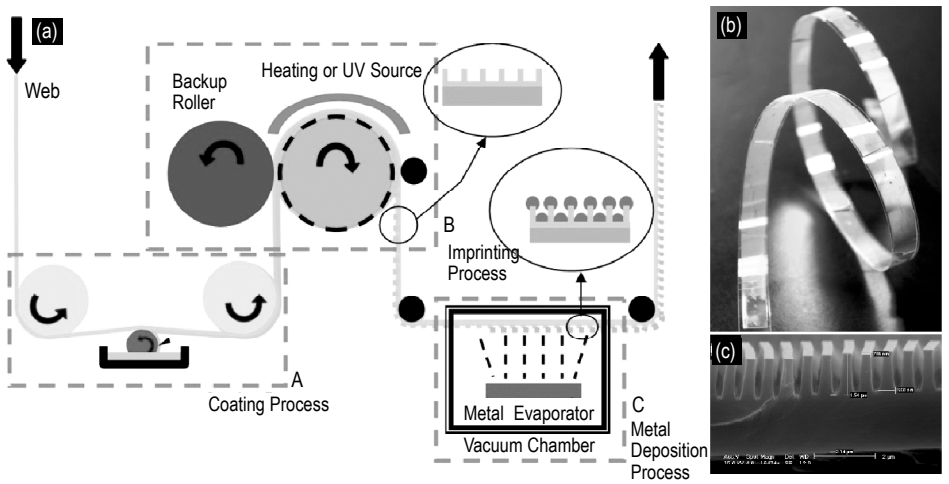

(a) Schematics of R2RNIL, (b) Photograph of 700nm grating on PET substrate (total length: 570mm) showing strong light diffraction, and (c) a SEM of the grating.

Nanoimprint lithography (NIL) is considered as one of the most promising and competitive technologies for high-throughput and low-cost nanopatterning. However, the throughput in NIL is still far from meeting the demands of many practical applications, such as in organic electronics and biotechnologies. A faster and more economical fabrication method based on continuous Roll-to-Roll NanoImprint Lithography (R2RNIL) provides a practical solution for large-area nanoscale patterning. R2RNIL offers greatly improved throughput by overcoming the challenges faced by conventional NIL in maintaining pressure uniformity and successful large-area imprinting and demolding. We demonstrated a prototype printer capable of continuous imprinting of nanoscale structures on a flexible plastic substrate. Our new process used a flexible and non-sticking fluoropolymer mold, and fast thermal and UV curable liquid resist materials developed previously in our lab. Large-area, nano-grating patterns with linewidth down to 70nm have been successfully replicated continuously. As one of its many applications, high-efficiency (extinction ratio~10^3) flexible polarizers are demonstrated. This research is supported by AFOSR (Grant No. F064-006-0084), NSF (Grant No. CMII 0700718), and the University of Michigan Technology Transfer Office (GAP Fund).