

Bilayer Wire-Grid Polarizers Fabricated by Roll-To-Roll Nanoimprinting on Flexible Plastic Substrates

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Polarizer is an important optical element used in a variety of applications. Wire grid polarizers in the form of sub-wavelength metallic gratings are an attractive alternative to conventional polarizers, because they are compact and planar and can provide high extinction ratios with transmittance (TM-polarized light) and reflectance (TE-polarized light) over a wide incident angle and wavelength range.

Fabrication of nanoscale metallic wire-grids on an optically transparent substrate mostly involves reactive ion etching or special sidewall deposition processes. Ekinci et al have recently demonstrated a new bilayer metal wire-grids with superb performance [1]. The bilayer metal wire-grid can be considered as two metal gratings separated by a certain distance. Not only this type of new polarizer provides very high extinction ratio between lights of two orthogonal polarizations, but also it offers the advantage of easy fabrication and defect tolerance.

In our work, we demonstrate fabrication of metal wire-grid polarizer on flexible plastic substrate by a continuous roll-to-roll nanoimprint lithography (R2RNIL) process (Fig. 1 and 2) and evaluate its performance. 70 nm linewidth grating structures were imprinted in a UV curable resist by using a flexible fluoropolymer mold fixed on a motor-activated roller. Various thicknesses of aluminum were deposited onto imprinted polymer gratings to form bilayer wire-grid polarizers. Extinction ratio exceeding 100 has been achieved (Fig 3) in an initial test. The performance the polarizer can be significantly improved by optimizing parameters such as grating period, depth and metal thickness. This approach has the potential to become a commercially viable technology for low-cost production of high performance wire-grid polarizers from UV to NIR wavelength range.

[1] Y. Ekinci, H. Solak, C. David and H. Sigg, Optics Express, 2006

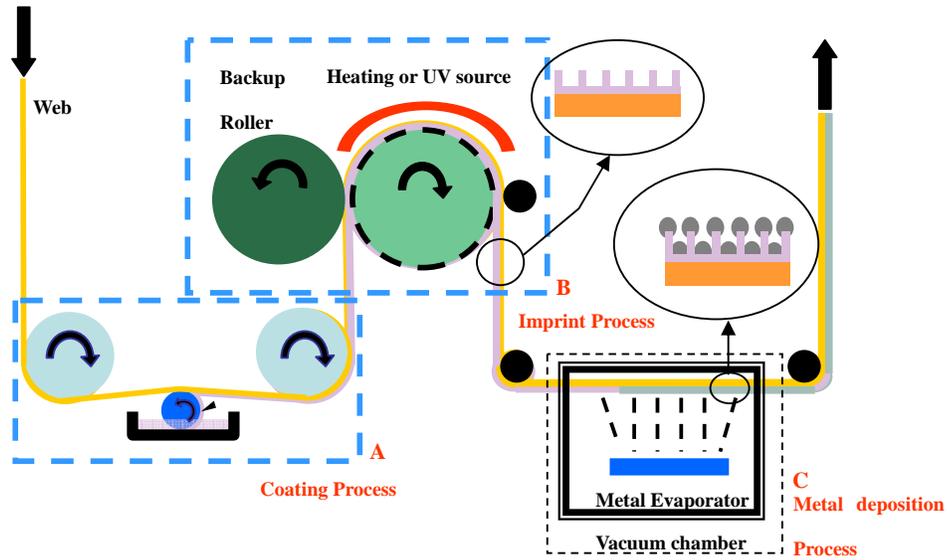


Fig. 1 Schematics of R2RNIL process to fabricate metal wire-grid polarizers

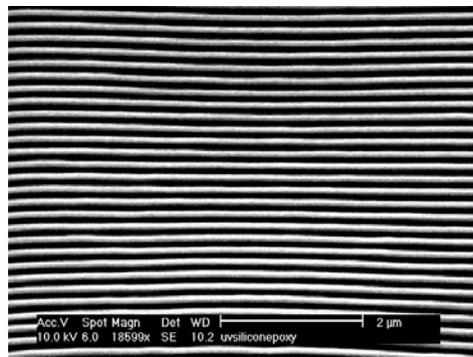


Fig. 2 SEM image of 70 nm linewidth grating structures fabricated by R2RNIL

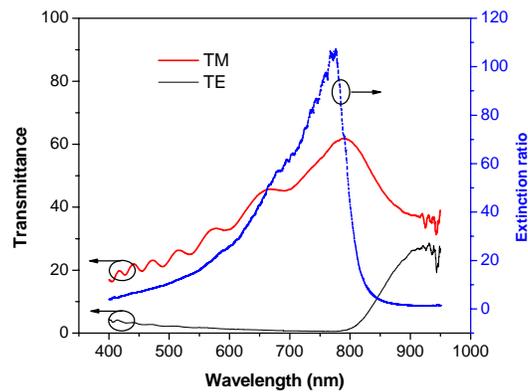


Fig. 3 Spectral transmittance and extinction ratio of the bilayer wire-grid polarizer fabricated by R2RNIL technique.