Wire-Grid Polarizer Fabricated by Nanoimprint Lithography and Double Evaporation

Young Jae Shin[1], Carlos Pina-Hernandez[1], Hui Joon Park[1],
Moon Kyu Kwak[2], Jong G. Ok[3], *Peng-Fei Fu*[4], and L. Jay Guo[1,2,3]
[1]*Macromolecular Science and Engineering,* [2]*Departmnet of Electrical Engineering and Computer Science and* [3]*Department of Mechanical Engineering,*
University of Michigan, Ann Arbor, MI 48109
[4]*Dow Corning Corporation, Midland, Michigan 48686*

Wire-grid polarizer (WGP) has demonstrated good polarization efficiency, wide view angle, long-term stability, and the potential to integrate with other optical components.[1,2] The WGP for visible light requires a fabrication of subwavelength metal gratings, which presents significant challenge for patterning and etching of dense and subwavelength gratings. In this study, we report a new WGP fabrication method that greatly relaxes the requirement on patterning and etching. The technique is to pattern a high aspect-ratio and narrow linewisth grating by nanoimprint lithography and followed by two-times angled Aluminum deposition at the opposite direction to produce narrow spacing between the Al lines.

We previously reported that the large area high resolution patterning could be conducted using epoxysilsesquioxane (epoxy-SSQ) by NIL.[3] The NIL was conducted using epoxy-SSQ for WGP in this study. The formulation of the nanoimprint resist is prepared by dissolving an epoxy-SSQ resin in propylene glycol monomethyl ether acetate and followed by the addition of a photoacid generator (PAG). The thickness of the obtained film could be controlled by spin coating. The SSQ resin solution is spun on a hard glass substrate or cast on a PET film on which the surface was previously treated with O_2 plasma. The imprinting process is performed under UV light exposure within a few seconds at room temperature. The imprinting pressure is typically less than 40 psi due to the low viscosity of the liquid resist. The SEM image of SSQ nano pattern on the glass was shown in Fig. 1.

After the imprinting process, Al deposition is followed by Al evaporation at a 40 degree. The process is repeated at the opposite direction to make the Al deposition on both sidewalls. The schematic view of the wire grid polarizer prepared in this study was shown in Fig. 2.

In Fig. 3, the measured transmission spectrum after 20 nm thickness of Al deposition was shown. The maximum TM is 91% and the minimum TE is 0.6%. The fabrication of the WGP only involves the imprinting and the metal deposition, and does not include any etching process and other laborious process.

1) F. Meng, G. Luo, I. Maximov, L. Montelius, J. Chu, H. Xu, Microelectron. Eng. 88, 3108 (2011)
2) L. Chen, J. J. Wang, F. Walters, X. Deng, M. Buonanno, S. Tai, X. Liu, J. Vac. Sci. Technol. B 25, 2654 (2007)
3) C. Pina-Hernandez, L. J. Guo, P.-F. Fu, ACS Nano, 4, 4776 (2010).

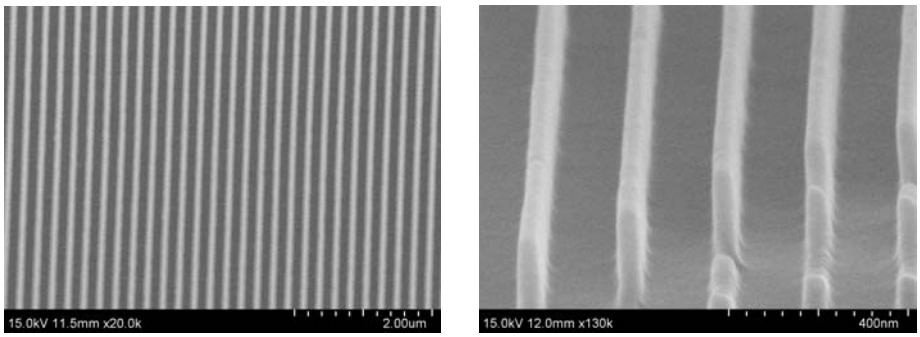

Fig. 1. The SEM image of the imprinted SSQ nano grating on glass substrate.

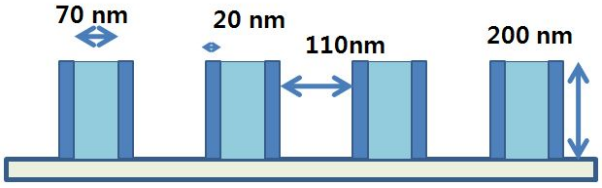

Fig. 2. Schematic view of the wire grid polarizer prepared in this study.

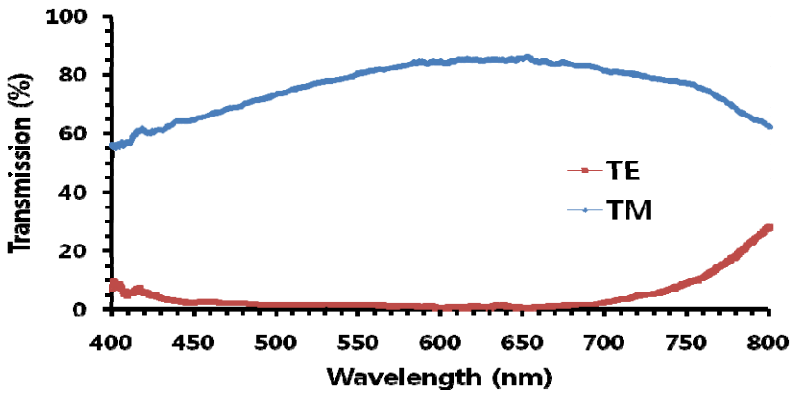

Fig. 3. The measured transmission spectra after 20 nm thickness of Al deposition. Maximum TM is 91% and minimum TE is 0.6%.