Fabrication of Antireflective Silver Mesh Electrode with Moth-Eye Structure by Combination of Photolithography and Nanoimprint Lithography

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Silver mesh transparent electrodes with micrometer-scale patterns are widely used in touch panel applications [1]. However, external light reflection from the non-electrode regions significantly reduces visibility. To address this issue, we developed a novel fabrication process that integrates moth-eye nanostructures [2] in non-electrode regions to achieve antireflective properties while maintaining electrical conductivity.

Figure 1 shows developed process. This fabrication process consists of the following steps: First, photosensitive silver ink was applied onto a moth-eye-structured mold and patterned using photolithography to form silver mesh electrode regions (Fig. 1(a-h)). Subsequently, UV-curable resin was coated over the patterned surface, and nanoimprint lithography was performed to transfer the moth-eye structure (Fig. 1(i-l)). After UV curing, the film was demolded from the master mold, resulting in a transparent film featuring both silver mesh electrodes and moth-eye nanostructures in the non-electrode regions (Fig. 1(l)).

Figure 2 shows cross-sectional SEM images of the fabricated film. SEM observations confirmed successful formation of the moth-eye structure (height: ~247 nm) in non-electrode regions. Figure 3 presents the optical properties of films with and without moth-eye structures. Optical characterization revealed that films with moth-eye structures exhibited improved transmittance from 81% to 88% and significantly reduced reflectance from 4.6% to 0.7%, compared to conventional silver mesh films without nanostructures.

This fabrication method enables simultaneous formation of conductive silver patterns and antireflective nanostructures, offering improved visibility for touch panel displays and other transparent electrode applications.

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[1] D. S. Hecht, L. Hu, and G. Irvin, Adv. Mater. **23**, 1482 (2011).
[2] J. Taniguchi, Y. Ohno, and S. Takeda, Micro Nano Eng. **8**, 100077 (2020).

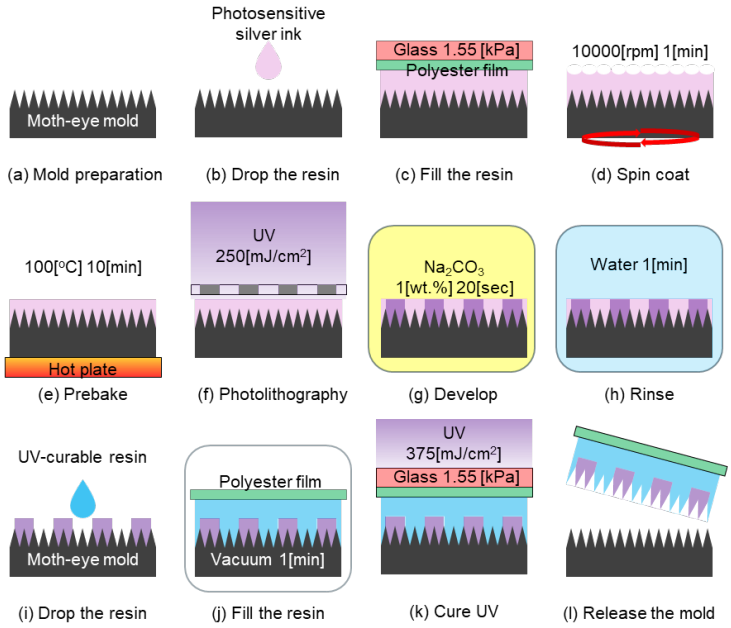

Fig 1. Fabrication process of the film

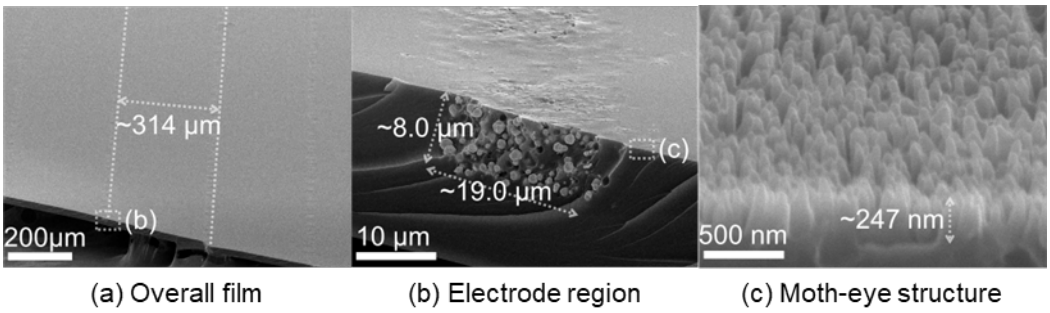

Fig. 2 Cross-sectional SEM image of the fabricated film

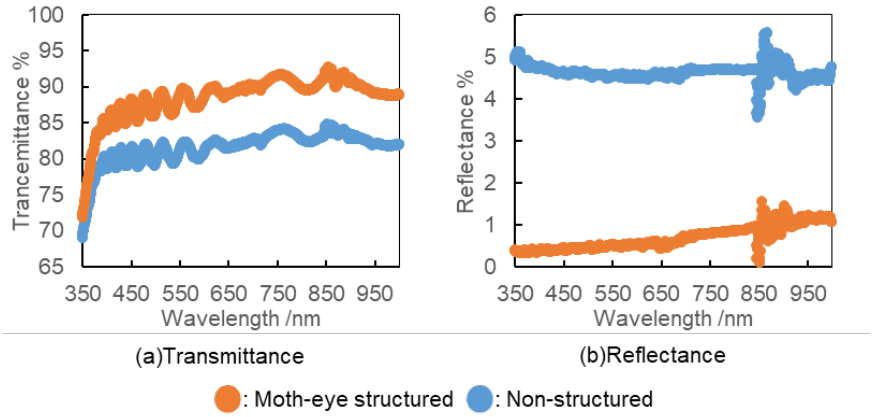

Fig. 3 Comparison of optical properties between the fabricated film with moth-eye structure and the film without moth-eye structure