High Performance Transparent Conducting Electrode Film Using Surface-Embedded Metal Nanotrough Network

Hyeon-Gyun Im[1], Byeong Wan An[2], Junho Jang[1], Jang-Ung Park[2], and Byeong-Soo Bae[1]
[1]Dept. of Mater. Sci. Eng., KAIST, Daejeon 373-1, Korea
Tel.:82-42-350-4119, E-mail: bsbae@kaist.ac.kr
[2]Sch. of Mater. Sci. Eng., UNIST, Ulsan 689-798, Korea

Transparent conducting electrodes (TCE) are an essential component for flexible optoelectronics such as display, solar cells, organic light emitting diodes, and touch screen panels. Recently, indium tin oxide (ITO), most widely used TCE material to date, has faced challenges due to its rising-cost and inherent brittleness, that make it unsuitable for flexible optoelectronics. Potential alternatives to ITO include metal nanowires (NW), meshes, and nanotroughs. In particular, percolating networks of the one-dimensional metal nanotroughs have superior opto-elelctrical performances compared to metal NWs and meshes. In addition, metal nanotroughs have excellent mechanical flexibility under both bending and stretching stresses.[1] However, the nanotroughs have several disadvantages such as large surface roughness, poor adhesion to the substrate, and instability of the material in harsh environments.

We report on a flexible hybrid conducting (nanotrough-GFRHybrimer) film using surface-embedded metal nanotrough network as a TCE materials and glass-fabric reinforced composite (GFRHybrimer)[2] film as a basal substrate. Embedded structure of nanotrough network on the surface of the GFRHybrimer film provides extremely smooth surface topography (R_{rms} < 1 nm), strong adhesion (10^3 cycles of peeling-off test), and highly improved thermal stability (250 ºC/24 hrs). Excellent opto-electrical performance of nanotrough-GFRHybrimer film is observed due to its junction-less network (R_{sh} = 2 Ω/sq at T = 83 %). We expect that nanotrough-GFRHybrimer film can be a promising platform for high-performance optoelectronic devices.

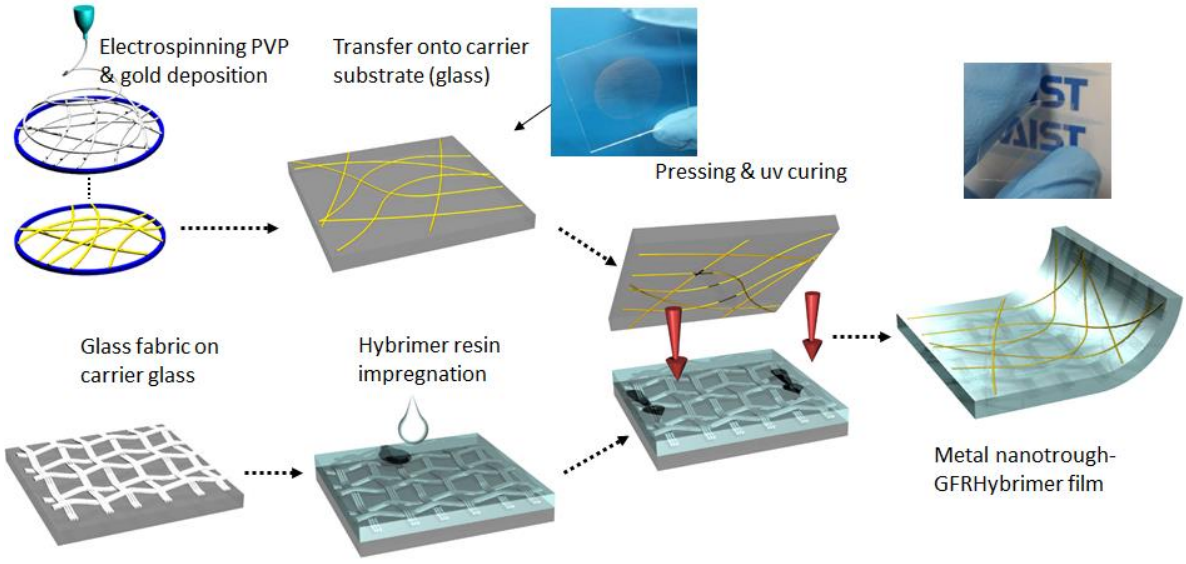

Fig. 1. Schematic illustration of the fabrication procedure for nanotrough-GFRHybrimer film.

References

1. B. W. An, B. G, Hyun, S.-Y. Kim, M. Kim, M.-S. Lee, K. Lee, J. B. Koo, H. Y. Chu, B. S. Bae, and J.-U. Park, *Nano Lett.*, 14, 6322-6328 (2014).
2. J. Jin, J.-H, Ko, S. Yang, and B. S. Bae, *Adv. Mater.*, 22, 4510-4515 (2010)