Transfer Printing Method for Ag-Ink-Based Conductive Electrode on Flexible Substrate by Utilizing Self-Aligned Polymeric Anchor Structure

Joon-Chan Choi, Ji-sub Park, Min-Kyu Park, Imtiaz Mahmud and Hak-Rin Kim
School of Electronics Engineering, Kyungpook National University, Daegu, 702-701, Korea
Tel.:82-53-940-8622, E-mail: rineey@ee.knu.ac.kr

Fabrication process of highly conductive electrode pattern on flexible substrate using printing process has a great attention in terms of mass production and cost-effectiveness. However, the electrode made by metal ink has low conductivity due to capping and binding materials mixed in that. Therefore, sintering process is needed to improve the conductivity of electrode. However, the sintering process is difficult to apply on flexible substrate because of damaging and deformation of film. In this paper, we demonstrated a novel method to fabricate a highly conductive electrode using metal ink with transfer printing method[1-3] to applying an anchor structure. We screen-printed Ag electrode pattern on glass substrate coated polymeric buffer layer using Ag ink. Ag electrode pattern was sintered on the hot plate at 280 ℃ for 1 hour to increase conductivity. The resistivity of Ag electrode pattern with thermal sintering at 280 ℃ for 1 hour obtained in two orders lower resistivity than the thermal treatment at 120 ℃ for 1 hour as shown in Fig. 1. After sintering process, Ag electrode was not picked-up by elastomeric stamp without polymeric buffer layer etching process because adhesion energy between Ag electrode pattern and polymeric buffer layer was very large by the binding material mixed in Ag ink. Therefore, we applied a polymeric buffer layer etching process to reduce the attached area between Ag electrode pattern and polymeric buffer layer for reducing adhesion energy. In this case, the etched polymeric buffer layer was played a role in anchor structure. Therefore, the electrode was not disheveled. In our experiment, almost 100 % pick-up yield of Ag electrode pattern was achieved for 5 minutes etching time. To enhance the printing yield, we coated cellulose ether at the bottom of Ag electrode pattern by micro contact printing method and printed on polyethylene terephthalate (PET) substrate. We observed superior bending stability that Ag electrode pattern had not cracks and detachment under the harshly bending stress (Bending radius: 3 cm).

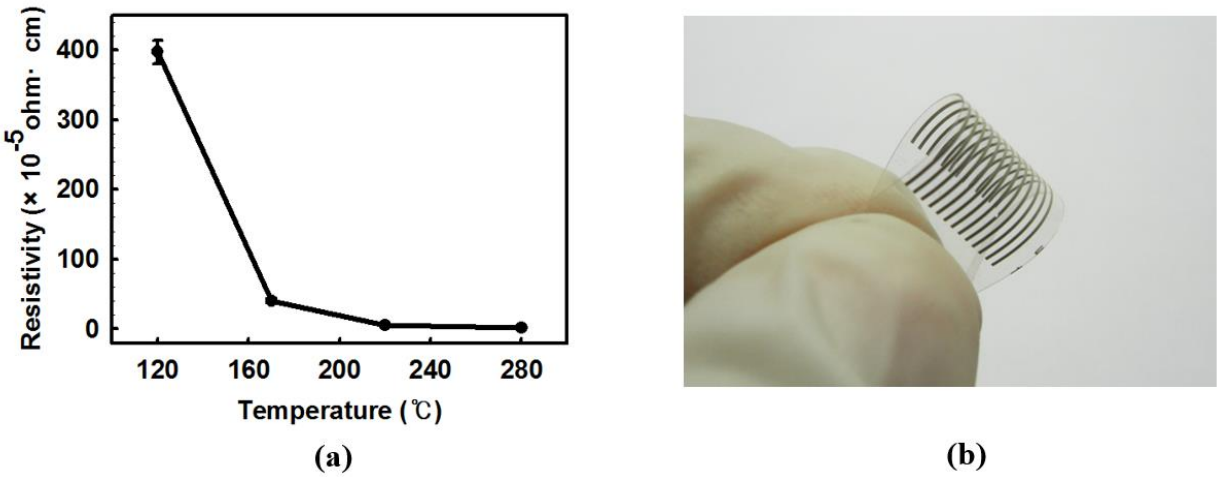

Fig. 1. (a) The resistivity of the Ag electrode pattern at thermal sintering temperatures in 1 hour and (b) image of transfer-printed Ag electrode pattern on PET substrate.

References

1. A. Carlson, A. M. Bowen, Y. Huang, R. G. Nuzzo and J. A. Rogers, *Adv. Mater.*, 24, 5284 (2012).
2. R. S. Dahiya, A. Adami, C. Collini and L. Lorenzelli, *Microelectron. Eng.*, 98, 502 (2012).
3. Y. Sun and J. A. Rogers, *Nano Lett.* 4, 1953 (2004).