Fabrication of Au/PEDOT/PSS Stacked Electrodes of OTFTs by Imprinting Technology

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Abstract
The organic thin film transistors (OTFTs) have become the potential candidates for low-cost and flexible electronics application. The imprint techniques had been demonstrated to fabricate the micro- and nano-scale metal pattern for OTFTs [1-3]. In this work, the metal/polymer stacked source/drain electrodes of OTFTs were fabricated by combining the micro-contact inking and reversal imprinting. The PEDOT/PSS polymer was inked with the Au coated mold. Then, the Au/PEDOT/PSS stacked electrodes of OTFTs were reversal imprinted onto the pentacene. The channel length of OTFTs was scaled down to ~3µm. And the source/drain contact resistance of organic TFTs was improved by the proposed process.

In our experiment, the PEDOT/PSS was spin-on coated on Si wafer and baked for 2 minutes. Then, as shown in Fig. 1, the Au coated mold was placed naturally on the PEDOT/PSS coating surface for 1 minute and inked with the PEDOT/PSS. Fig.2 shows the fabrication of OTFTs. The electrode was fabricated on the pentacene with the imprinting condition of 90-120 °C, 100-300 psi, for 3min. The OTFTs channel width/length is about ~150-750µm/~3-75µm. The electrical characteristics of OTFTs were measured by HP 4156. The contact resistance was extracted using the transmission line method (TLM). Fig. 3(a)-(b) show the photography and microscope (OM) image of Au/PEDOT/PSS stacked electrode imprinted on flexible polyimide substrate. The electrodes were transferred effectively. The yield of transferring of electrodes on the pentacene substrate is also about ~90%.

Fig. 4(a)-(b) show the electrical output and transfer curves of OTFTs with the imprinted Au/PEDOT/PSS stacked electrode. The threshold voltage, on-off ratio, and carrier mobility of OTFTs with the stacked electrode are about ~ -18.6 (V), 1.3 × 10 4, and 3.1 × 10 -3 (cm2/Vs), respectively. The source/drain contact resistance of pentacene OTFTs with the Au only and Au/PEDOT/PSS stacked electrode were shown in Fig. 5(a)-(b). The OTFTs with Au/PEDOT/PSS stacked electrode had lower contact resistance than that of OTFTs with Au only electrode.

In conclusions, the above results suggest that the proposed technique is suitable for the future low-cost and flexible electronics applications.

References

Figures

Fig. 1 Inking process of PEDOT/PSS inter-layer.

Fig. 2 Fabrication of OTFTs with the Au/PEDOT/PSS stacked electrode.

Fig. 3 The (a) photography and (b) OM images (50X) of Au/PEDOT/PSS stacked electrode imprinted on flexible polyimide substrate.

Fig. 4 The (a) electrical output and (b) transfer curves of OTFTs with the imprinted Au/PEDOT/PSS stacked electrode.

Fig. 5 The contact resistance of pentacene TFTs with the (a) Au only and (b) Au/PEDOT/PSS stacked electrode.

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