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Reverser off-set Printing Process for Gate Electrodes of OTFT-Backplane

Ji-eun Park[1], Mi-young Lee[2] and Chung-kun Song[1,2]

[1]Univ. of Dong-A, Dept. of Electronics Engineering, 840, Hadan-2 dong, Saha-gu, Busan 604-714, Korea
[2]Univ. of Dong-A, Media device lab, 840, Hadan-dong, Saha-gu, Busan 604-714, Korea
Phone: +82-51-200-6965 E-mail: jeunchu@naver.com

1. Introduction

Recently, it goes to the printing technique in which it makes the organic thin film transistor (OTFT) with an off-set, a flexo, the direct, an ink-jet, and a grarvure off-set printing[1,2]. As to the existing photo lithography process, by using the overhead vaccum deposition equipment, we used many processing procedures. Printing processes are attracting much attention because of the low cost and high compatibility with plastic substrate.

However, the large area printing was impossible and did not use all printing process [3]. OTFT-backplanes for flexible displays are a suitable application of printing process because the organic materials can be a good candidate for printing process. In OTFT-backplane the gate electrodes and scan bus lines, which are directly connected to the gate electrodes, require high conductivity and high resolution and thin enough for the good step coverage of the subsequent gate dielectric.

In this paper we developed a printing process for the gate electrode and scan bus lines by combining screen printing and reverse off-set printing with Ag ink as a conducting ink.

2. Experiment

First, Ag ink was uniformly printed over the entire area of substrate by screen printing. And then etching resist (ER) was deposited and patterned by reverse off-set printing over the Ag ink layer. Subsequently the opened Ag ink was etched off and then the ER was stripped off to obtain the final patterns.

In Fig.1 the reverse off-set printing consists of three steps; coating step of ER on blanket by slit coating, patterning step by transferring ER on blanket to cliche, printing step by transferring the remaining ER on blanket to substrate.

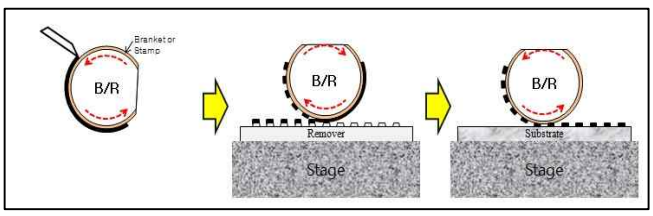


Fig. 1. The schematics of reverse off-set printing process of etching resist on the uniform Ag ink layer coated by screen printing.

In coating step it is important to uniformly coat ER on blanket without pinholes. In patterning step the ER on blanket should be completely transferred to cliché without the residual ER on the selected areas of blanket. In printing step the remaining ER should be completely transferred to Ag ink layer on substrate.

In order to satisfy the above important requirements it is essential to find out an appropriate solvent. Thus we examined the contact angle and surface tension of ER when mixed with the various solvents and found out the coating ability on blanket.

3. Results and discussion

As shown in Fig.2 ethyl acetate produced the smallest contact angle and IPS exhibited the smallest surface tension. Thus, the ER was mixed with ethyl acetate and IPA, respectively.

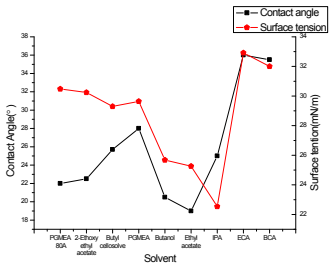
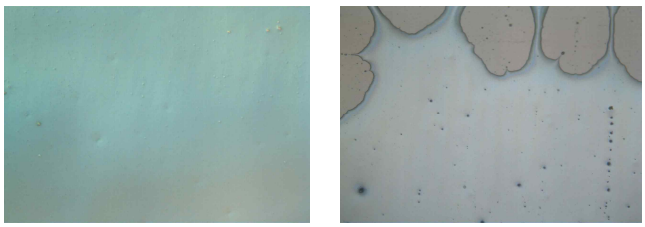


Fig. 2. Contact angle and Surface tension measurements of solvent with blanket

However, both ER produced pinholes when coated on blanket. Therefore, a F-related leveling agent was added by 3 % to remove pinholes as shown in Fig 3.



(a) (b)

Fig. 3. In case (a) wetting is excellent in the large area coating, (b) wetting is unable to be excellent and a pinhole is generated

The final solution of ER mixed with ethyl acetate and leveling agent produced a very uniform coating on blanket as shown in Fig.4 and also fine patterning and printing as shown in Fig.5. The final pattern of Ag ink layer exhibited 30 um feature size and 1 Ω/square of sheet resistance.

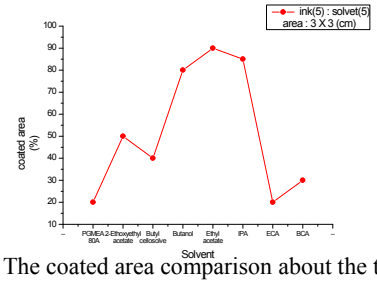


Fig. 4. The coated area comparison about the total area

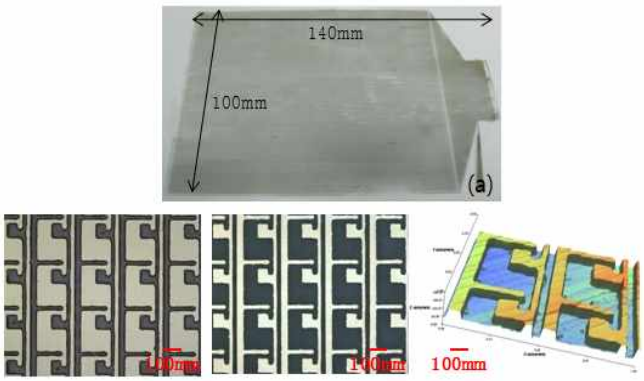


Fig. 5. In case (a) the gate electrode for the large area OTFT, (b) it becomes with printing, (c) after a strip-off, (d) 3D of the printed gate electrode

4. Conclusions

For gate electrodes and scan bus lines of OTFT-backplane, first, screen printing was applied to uniformly deposit Ag ink thin film over the entire area of substrate, and then etching resist was deposited and patterned by reverse off-set printing. The final gate electrodes were obtained through etching Ag ink layer in the exposed areas. By using this process the line feature of 50 um was easily obtained with the sheet resistance of 1 Ω /square.

Acknowledgements

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