SUPPLEMENT MATERIAL

Damage-free Back Channel Wet-etch Process in Amorphous Indium-zinc-oxide Thin-film Transistors Using a Carbon-nanofilm Barrier Layer

Dongxiang Luo,[†,‡,⊥] Mingjie Zhao,[†,‡,⊥] Miao Xu,[†,§,*] Min Li,[†,‡] Zikai Chen,[‡] Lang Wang,[‡] Jianhua Zou,[†,§] Hong Tao,[†,§] Lei Wang,[†,‡] Junbiao Peng[†,‡,ǂ,*]

[†]Institute of Polymer Optoelectronic Materials and Devices, South China University of Technology, Guangzhou 510640, PR China

[‡]State Key Laboratory of Luminescent Materials and Devices, Guangzhou 510640, PR China

[§]School of Electronic and Information Engineering, South China University of Technology, Guangzhou 510640, PR China

[ǂ]Guangzhou New Vision Optoelectronic Co., Ltd., Guangzhou 510530, PR China

Corresponding Author

[*] E-mail: xumiao4049@gmail.com (M. Xu); psjbpeng@scut.edu.cn (J. Peng).

Adhesion tape test according to the ASTM-D3359 was carried out to evaluate the adhesion of Mo/C film on glass substrate. For the adhesion test, the film was cut into a 1 mm×1 mm×25 lattice pattern by a blade, as shown in Fig. 1a. Then a pressure sensitive tape was applied over the lattice and then removed. After the adhesion test, as shown in Fig. 1b, no peel off is observed in the lattice pattern of the stack film. This result suggests that the adhesion of the Mo/C stack film to the glass substrate is good

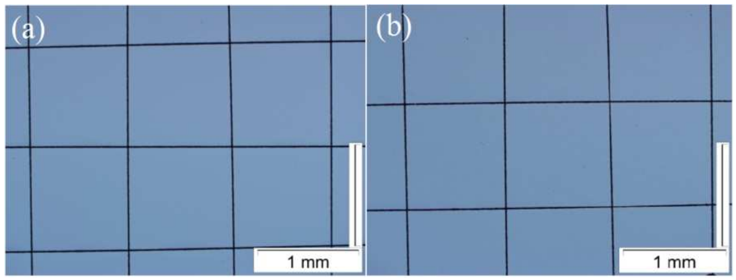

FIG.1. Before (a) and after (b) the adhesion test of the Mo/C/IZO film stack on glass substrate

Figure 2 shows the line-profiling EDS analysis in the TEM test. The line profile proved uniform distributions of Zn and In elements in the IZO channel layer. Moreover, it was found that the Mo/C/IZO structure exhibited a relatively sharp interface, indicating slight inter-diffusion effects between Mo and IZO. Thus, the presence of C nanofilm can effectively prevent the diffusion of Mo into IZO.

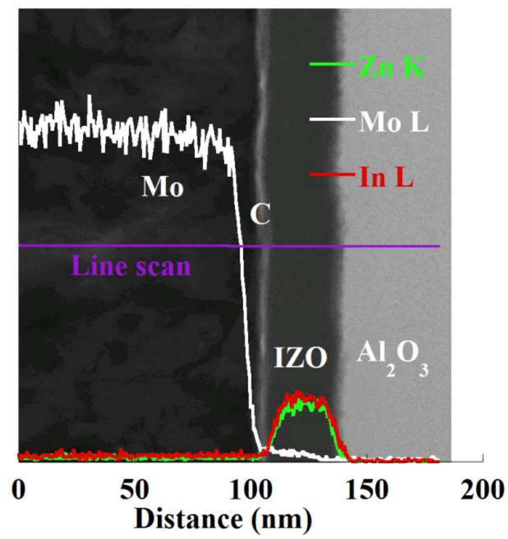

FIG.2. TEM line profile of the IZO-TFT with a 3-nm-thick C-interlayer, the device was annealed at 300°C in air for 30 minutes.

Figure 3 shows positive bias thermal stress (PBTS, V_{GS} =20 V, 80 ^{o}C) and negative bias thermal stress (NBTS, V_{GS} =-20 V, 80 ^{o}C) stability of the IZO-TFTs with 1.5-nm-thick C barrier layer, respectively. It was observed that the V_{th} shifted 2.9 V and -0.3 V under PBTS and NBTS, respectively. The inferior stability should be ascribed to the damages at the back channel of IZO.

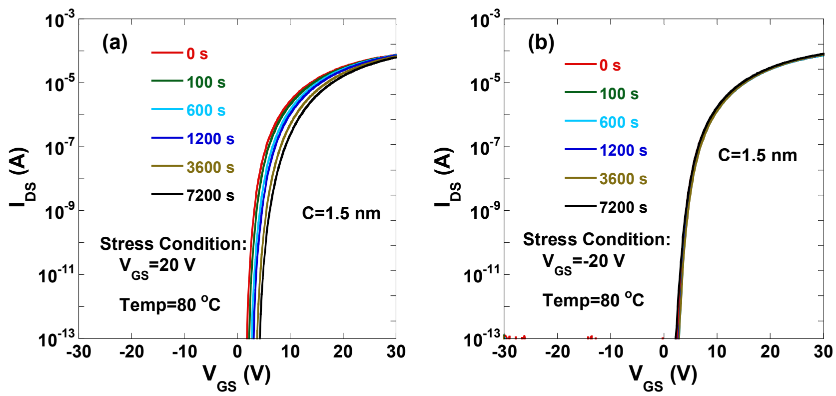

FIG. 3. The variations of time-dependent transfer property under (a) PBTS (V_{GS} =20 V, 80 ^{o}C) and (b) NBTS (V_{GS} =-20 V, 80 ^{o}C) for the IZO-TFT with a 1.5-nm-thick C-interlayer.

To evaluate the contact resistance (Rc) of the IZO/Mo stack without the carbon film, the BCE-type IZO-TFTs were fabricated by dry etching using mixture of CF_4 and O_2 as process gas. The Rc for the devices with W of 100 μm and L of 5, 10, 20, 30, and 40 μm was extracted from TLM method. As shown in Fig. 4, the width-normalized R_c (R_cW) is evaluated to be 100 Ωcm. The value of contact resistance is comparable with that of IZO-TFT with 3-nm-thick C barrier layer. In our optimized device, the contact resistance is just only 80 Ωcm, which suggests that the C barrier layer insertion between IZO and Mo electrode has a negligible effect to the IZO/Mo stack contact property, probably due to the carbon barrier at the IZO/Mo interface has a low resistivity after annealing.

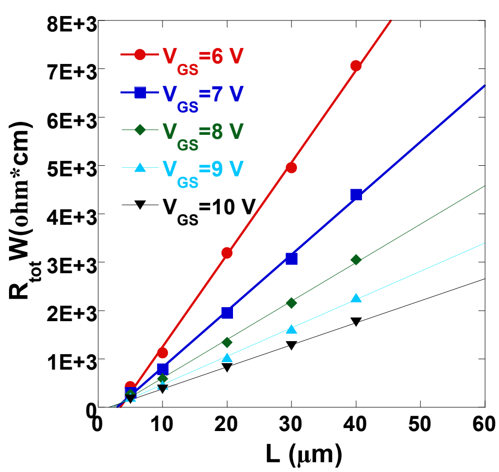

FIG. 4. Dependence of R_tW on L for the IZO-TFT without C barrier layer.