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Sol-gel 공정으로 제작된 산화물 반도체 박막 트랜지스터

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Sol-gel processed oxide semiconductor thin-film transistors for active-matrix displays

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Abstract - Zinc tin oxide (ZTO) based thin-film transistors (TFTs) were fabricated on glass substrate by using sol-gel method. The fabricated ZTO TFT had bottom gate and top contact structure with ZTO layer formed by spin coating from ZTO solution. The fabricated TFT showed field-effect mobility of about 2 - 4 $cm^2/V{\cdot}s$ with on/off current ratios $>10^7$, and threshold voltage of 2 V.

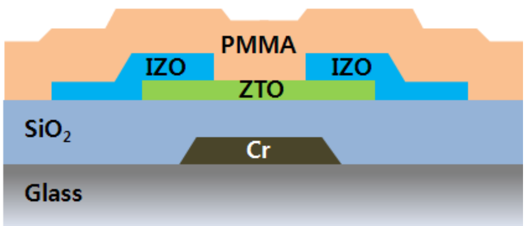
1. Introduction

Recently, oxide semiconductor based thin-film transistors (TFTs) receiving much attention in the field of display industry due to their relatively high electrical performance (>10 $cm^2/V{\cdot}s$) and as well as the electrical stability [1-3]. Currently most of the oxide semiconducting layers are deposited by sputtering or pulsed-laser deposition methods. However, it has been demonstrated that oxide semiconductor layers can be formed by means of solution process using sol-gel method [4]. The solution process of oxide semiconductor layer may enable low-cost and high throughput processes such as ink-jet printing, gravure printing and offset printing. In this report, a oxide semiconductor layer, zinc tin oxide (ZTO) was formed by sol-gel method and relatively high performing TFTs were fabricated on glass substrate.

2. Results and Discussion

2.1 Fabrication

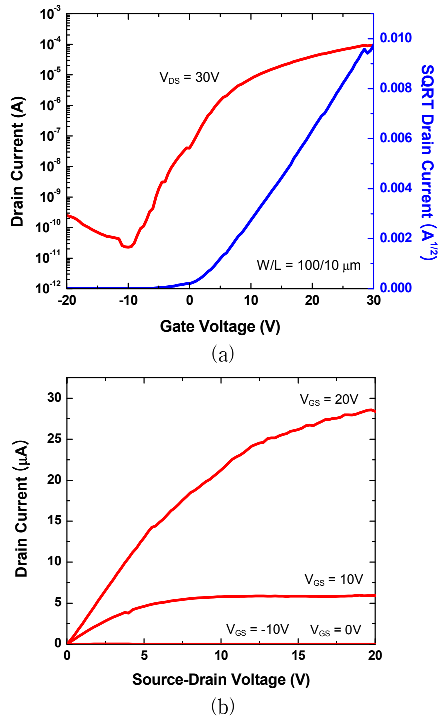
The fabricated TFT device had bottom gate and top contact structure. On a cleaned glass substrate, 130 nm-thick Cr gate electrode was deposited and patterned. On the gate electrode, 200 nm-thick SiO_2 was deposited by chemical vapor depositon (CVD). After depositing the gate dielectric, ZTO solution was spin coated to form 30 - 50 nm-thick films [REF]. After spin coating the film were annealed at 500℃for 1 hour at air ambient condition. For source and drain electrode, conductive indium zin oxide (IZO) layer was deposited by RF-magnetron sputtering and patterned by lift-off process. The channel lengths of the device were 5, 10 and 20 ㎛ and the channel widths were 100 and 200 ㎛. For a passivation layer, poly(methyl methacrylate) (PMMA) was spin coated on the sample. The electrical characteristics of the fabricated ZTO TFTs were measured under dark and air ambient condition. Figure 1 shows the schematic diagram of the fabricated ZTO TFTs.



<Figure 1> Schematic cross section diagram of fabricated ZTO based thin-film transistor

2.2 Results

Figure 2 shows I_D and $\log(I_D)$ versus V_{GS} characteristics for V_{DS} = 30 V, and I_D versus V_{DS} characteristics of the sol-gel processed ZTO TFTs. The device had a channel length of 10 ㎛, a channel width of 100 ㎛. The devices typically had extracted field-effect mobility of about 2 - 4 $cm^2/V{\cdot}s$ with on/off current ratios $>10^7$, and threshold voltage of 2 V.



<Figure 2> I_D and $\log(I_D)$ versus V_{GS} characteristics for V_{DS} = 30 V, and I_D versus V_{DS} characteristics of ZTO TFTs

3. Conclusion

Zinc tin oxide (ZTO) based thin-film transistors (TFTs) were fabricated on glass substrate by using sol-gel method. The fabricated ZTO TFT had bottom gate and top contact structure with ZTO layer formed by spin coating from ZTO solution. The fabricated TFT showed field-effect mobility of about 2 - 4 $cm^2/V{\cdot}s$ with on/off current ratios $>10^7$, and threshold voltage of 2 V.

[References]

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