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Tin oxide (SnO_2) based Thin Film Transistor: A Review

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***Abstract*— Amorphous oxide semiconductor materials significantly are used for thin film transistor due to high mobility and uniformity of the device. We examined the mobility, sub-threshold swing, threshold voltage, and on-off ratio of the various oxide materials. Various researchers have been widely examined IGZO based TFT due to its excellent electrical characteristics but IGZO materials have some drawback such as element scarcity and toxicity of indium. ITZO is the good choice material for used in transparent electronics. ITZO is used as an alternative material to IGZO because of its excellent stability and high mobility. On the other hand, indium based TFT experienced the stability problem in the device. Tin oxide based TFT is one of the material that is indium free oxide material SnO_2. SnO_2 has a reasonably high degree of mobility and outstanding stability, making it the ultimate material for transparent electronics applications.**

Keywords: Tin Oxide (SnO_2) TFT, Oxide semiconductor, Mobility

I. INTRODUCTION

The various applications in semiconductor industry such as liquid crystal display, different sensors and transparent electronics, thin film transistors are widely used. Different technologies have been used for thin film transistor fabrication as Amorphous silicon (a-Si),Low temperature poly-silicon (LTPS),Organic TFT,Oxide-TFT. a-Si technology based TFT is suitable because of high uniformity and low manufacturing cost. The leakage current of a-Si based TFT is minimal. The poor mobility of a-Si TFT (1 cm^2/V-s) prevents its use in high-resolution panels. Mobility is essential constraint in Organic light - emitting diode (OLED) display. Mobility is determining the speed or high current applications of the device. Therefore, the gate and data signals of the Active matrix liquid crystal display must be provided by IC chips adhered to the panel's perimeter. Using the LTPS method, however, the mobility is greatest (100 cm^2/V-s). The homogeneity is inadequate, and the processing costs are higher than those of competitors. Thus, LTPS is applied to small and medium-sized panels at now. Organic TFT may be manufactured on a big surface at a lower temperature and at a much cheaper price. Due to their poor mobility and instability, OTFTs are unsuitable for applications requiring a fast switching speed.

For oxide-TFTs, the mobility is uniformly situated between a-Si and LTPS. Oxide-TFT is characterized by greater film uniformitand much lower processing temperatures, enabling large-area applications with cheap production costs and large-sized LCD panels.

Thin film transistors based on amorphous oxide semiconductors have intriguing applications for big flat panel displays and organic light emitting LED backplanes (OLED).

The utilization of TFTs devices is contingent upon their low power consumption and outstanding electrical features, such as high mobility, low sub-threshold swing, high ON-OFF current ratio, low voltage operation, and good uniformity [1].The Table 1 shows the Comparative examination of various thin Film Transistors.

TABLE 1

Comparative examination of various Thin Film Transistors[2-3]

Parameter	a-Si TFT	Poly Si-TFT	Organic TFT	Oxide TFT
$\mu(cm^2/V-s)$	0.5-1	50-100	0.1-10	10-40
I_{on}/I_{off}	10^7	10^5	10^6	10^9
V_T	4.5	3.4	0.7	6
S(V/dec)	0.5	1.10	0.17	0.14
Uniformity (TFT to TFT)	High	Poor	Poor	High
Large area Uniformity	High	Poor	Poor	High
Bias and light stability	Poor	Good	Poor	Fair

II. OXIDE SEMICONDUCTOR BASED THIN FILM TRANSISTOR

Amorphous oxide semiconductor has superior property for low temperature fabricated flexible and transparent

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