A New Dual L-Gate Structure of Poly-Si TFT for Suppressing the Kink Effect in SLS/CW Laser Method

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Polycrystalline silicon thin film transistors (poly-Si TFTs) have attracted much attention for driving circuits in AMLCD and AMOLED due to high mobility and driving capability. Recently, new laser crystallization such as sequential lateral solidification (SLS) and CW laser method have been reported in order to improve the mobility of poly-Si TFTs [1,2]. However, kink effect is still remained due to the floating body of poly-Si TFTs.

The purpose of our work is to propose a new device structure for suppressing the kink effect of poly-Si TFT in SLS and CW laser method.

Various researches have been reported in order to eliminate the kink effect such as a lateral body terminal TFT and an asymmetrical dual gate TFT [3,4]. The lateral body terminal TFT is four terminal device and requires CMOS process. In three terminal devices, asymmetrical dual gate TFT is an effective structure to reduce the kink effect. However, the short channel sub-TFT of the asymmetric dual gate TFT has some problems of breakdown and reliability due to the field concentration.

We propose a new L-gate structure for suppressing the kink effect of poly-Si TFT. Figure 1 (a) shows the reported asymmetrical dual gate structure and figure 1 (b) shows the proposed dual L-gate structure. In the proposed device structure, we employed the difference of the number of grain boundaries in the channel as an asymmetric structure instead of the difference of gate length in the asymmetric dual gate structure. The proposed device does not employ a short channel sub-TFT, so that reliability of the device would be improved better than that of the asymmetric dual gate TFT.

Figure 2 shows the plane view of the proposed device. In the SLS, which is widely used for the crystallization of amorphous silicon film, poly-Si grains are grown toward an identical direction as shown Figure 2 [1]. Therefore, the grain boundaries of the sub-TFT A is less than that of the sub-TFT B. The asymmetric grain structure of the channel is substituted for the asymmetric gate structure, so that short channel effects do not occur in the proposed TFT.

Figure 3 shows the simulation results of conventional dual gate TFT and the proposed TFT. The conventional dual gate TFT was composed of 2 sub-TFT A. In the output curve of the proposed TFT, the total current was decreased due to the increase of channel resistance. However, the kink effect was considerably suppressed as shown in Figure 3.

We have proposed the new asymmetric L-gate poly-Si TFT, which could suppress the kink effect successfully without any additional process. We will also report an experiment result later.

Reference

[1] M. A. Crowder, J. Im et al., *IEEE Electron Device Letter*, vol. 19, p. 306, 1998.
[2] A. Hara et al., *IEDM*, p747, 2001
[3] J.S. Yoo, M. K. Han et al, *IEDM*, p. 217, 2000
[4] M. C. Lee, M. K. Han et al., *IEEE Electron Device Letter*, Vol 25. No. 1.p25, 2004

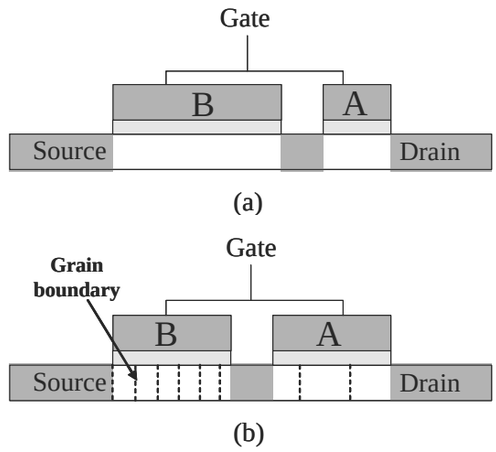

Figure 1 The device structures for suppressing the kink effect; (a) reported asymmetric dual gate TFT, (b) proposed dual L-gate TFT

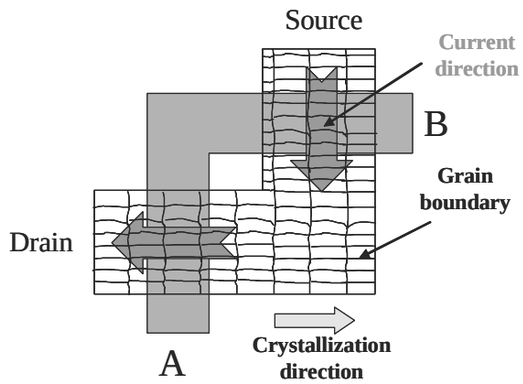

Figure 2 The plane view of proposed dual L-gate poly Si TFT

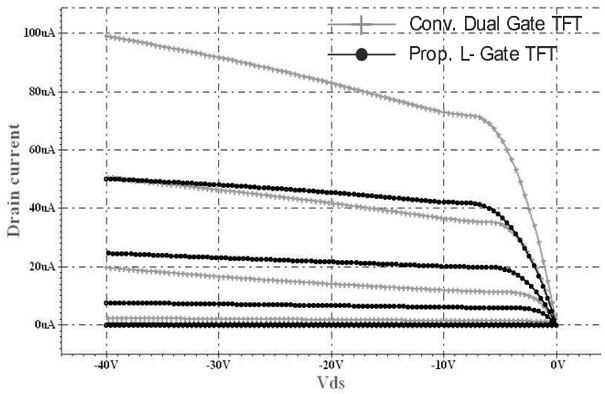

Figure 3 The output characteristics of a conventional dual gate TFT and the proposed TFT (p-type)