The Electrical Characteristics of the Poly-Si TFTs fabricated by 2-Dimensional Grain Growing ELA method

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INTRODUCTION

Polysilicon thin-film technology is becoming increasingly attractive for active-matrix liquid-crystal displays (AMLCD's) and other large-area electronic devices.(1) To achieve system on glass (SOG), high performance Si devices on a large glass substrate are necessary. The electrical characteristics of poly-Si TFT such as field-effect mobility and threshold voltage are dependent on the grain size and grain microstructure.(2) However, the grain size of poly-Si film recrystallized by conventional ELA may not be large enough for suitable device and circuit applications.(3)

EXPERIMENTS AND RESULTS

We have proposed a new ELA process employing floating active structure and multi channel structure. The proposed ELA method is illustrated in Fig. 1. It is well known that lateral temperature gradient in a melted Si film would induce the lateral grain growth.(4) In our proposed ELA method employing floating active structure and multi channel structure, temperature gradient is induced in two directions (x-axis, y-axis) so that 2-dimenstion grain growth occurs.

Fig. 2 shows the transfer characteristics of the proposed poly-Si TFT. Field effect mobility of n-channel TFTs and p-channel TFTs are $571 cm^2/Vs$ and $292 cm^2/Vs$, respectively. The high mobility value of the proposed TFT is due to the reduction of grain boundaries. To investigate reliability of the proposed poly-Si TFTs, the current source is biased at 1.2mA with grounded gate and drain electrode during 1000 seconds. Fig 4 shows the electrical characteristics change during the stress time. In spite of high current exceeding 1mA, the proposed poly-Si TFTs is scarcely degraded due to the high quality grain structure. We have also fabricated CMOS inverter. Fig. 4 shows the electrical characteristics of CMOS inverter since inverters constitute the main parts of the peripheral circuit. A small signal gain within the transition region is very high due to high field effect mobility of the proposed poly-Si TFTs.

CONCLUSION

We have fabricated high performance poly-Si TFTs by a new ELA method that 2-dimensional grain growth can be produced. Under the high current stress exceeding 1mA, the proposed poly-Si TFTs are scarcely degraded. We have also fabricated CMOS inverter with high inverter gain.

References

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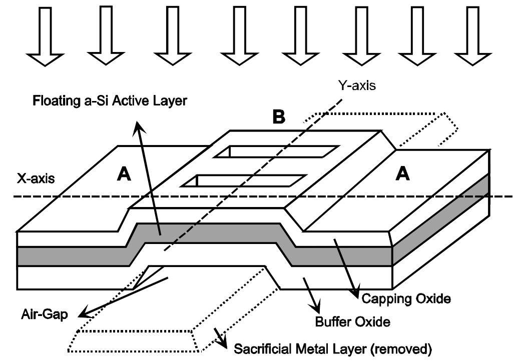

Fig. 1. Schematic diagram of the proposed ELA method.

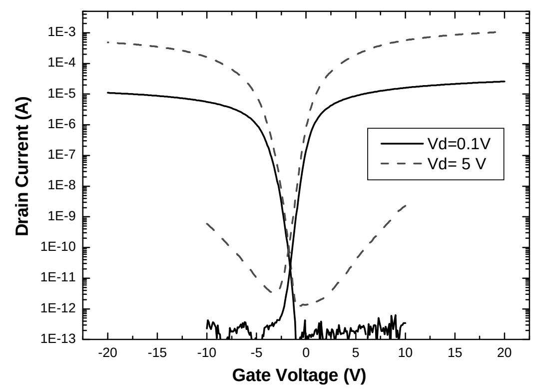

Fig. 2. Transfer characteristics of the proposed poly-Si TFT

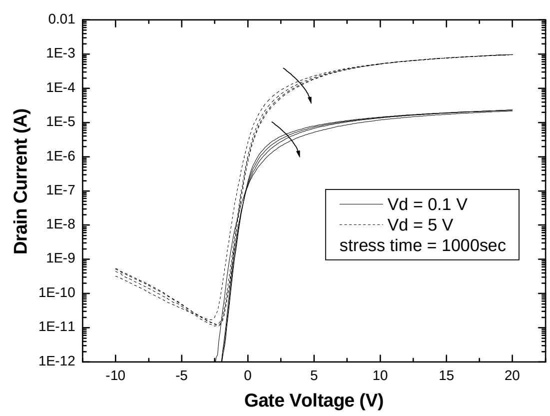

Fig. 3. The electrical characteristics change during the high current stress bias. Each sample is measured at 0s, 10s, 100s and 1000s.

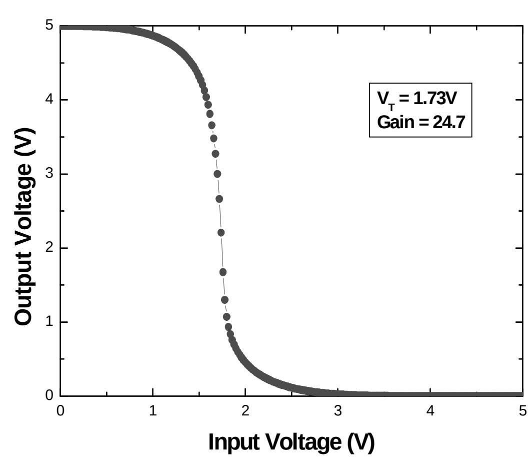

Fig. 4. Transfer characteristics of CMOS inverters