Application of Millisecond Solid Phase Crystallization of Silicon Films Induced by Micro-Thermal-Plasma-Jet to Bottom-Gate Thin-Film Transistors

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Introduction

Bottom gate thin film transistors (TFTs) fabricated with small grain polycrystalline silicon (poly-Si) film have been attracted much attention because of its advantages[1]. However, the conventional methods have some drawbacks such as low mobility as 5~7 cm^2/Vs, long thermal cycle, metal contamination. Micro-thermal-plasma jet (μ-TPJ) which can make millisecond solid phase crystallization (SPC)[2] of silicon films with good crystallinity, smooth surface and good electrical characteristics is a promised method for making bottom-gate TFTs with good performance.

Experimental

N-type bottom-gate TFTs fabrication diagram is shown in Fig. 1. Electrical characteristics of devices fabricated with different conditions of μ-TPJ are investigated.

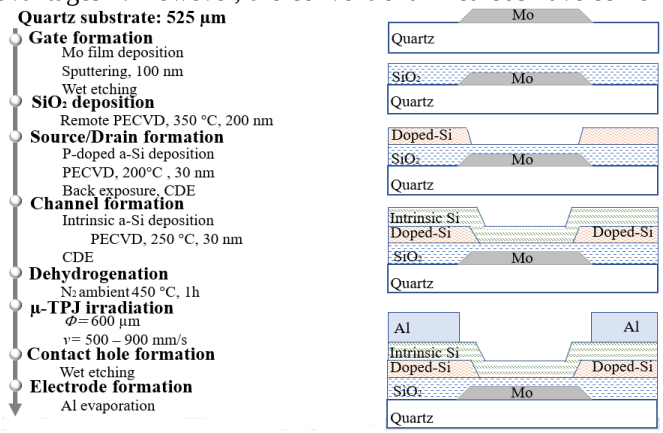

Fig.1. Bottom-gate TFTs fabrication process diagram

Results and discussion

Figure 2 (a) and (b) show transfer characteristics, field electron mobility μ_{FE} and output characteristics of bottom-gate TFT with dimension as length L/ width W = 80/10 μm. The millisecond SPC film was formed by μ-TPJ under v of 500 mm/s. The millisecond SPC-Si TFTs show high μ_{FE} of 28 cm^2/Vs. Figure 3 (a) shows the transfer characteristics of 30 devices fabricated with millisecond SPC film. As shown in Fig. 3 (a), there is small variation among devices. It is the result of small grain size and random orientation of millisecond SPC film. Figure 3 (b) show the I_d - V_g curve of transistor with dimensions as L/W = 80/20 μm when the millisecond SPC formed under different condition of v. The performance of devices becomes worse when v increases. This result suggests millisecond SPC film formed at slow v is a good candidate for small grain bottom-gate TFTs fabrication.

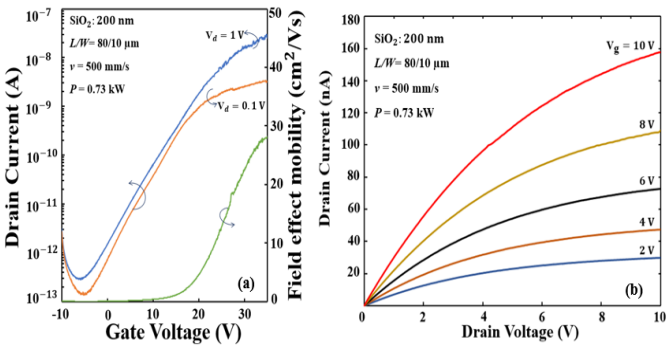

Fig.2. (a) Transfer characteristic, μ_{FE}, (b) output characteristics of TFTs fabricated with millisecond SPC

References

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Acknowledgement

This work is partly supported by Adaptable and Seamless Technology transfer Program through Target-driven R&D (A-STEP) from Japan Science and Technology Agency (JST) Grant Number JPMJTR20RS. A part of this research was supported by Research Institute for Nanodevice and Bio System (RNBS), Hiroshima University

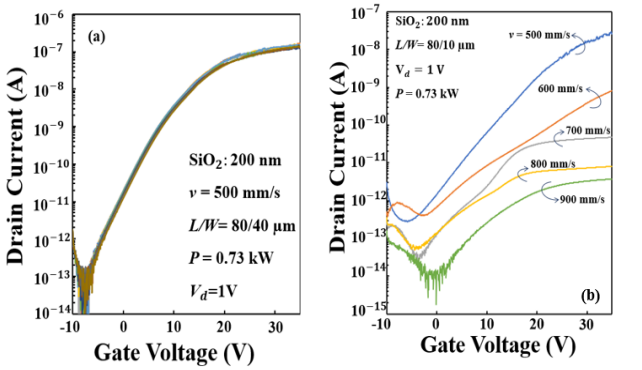

Fig.3. Transfer characteristic of (a) 30 TFTs fabricated with millisecond SPC formed under v as 500 mm/s (b) TFTs fabricated with millisecond SPC formed under different v