Nano-crystal silicon and amorphous indium gallium zinc oxide base nonvolatile memory device using mobile protons via insertion hydrogen neutral beam treatment process during normal thin film transistor process at room temperature

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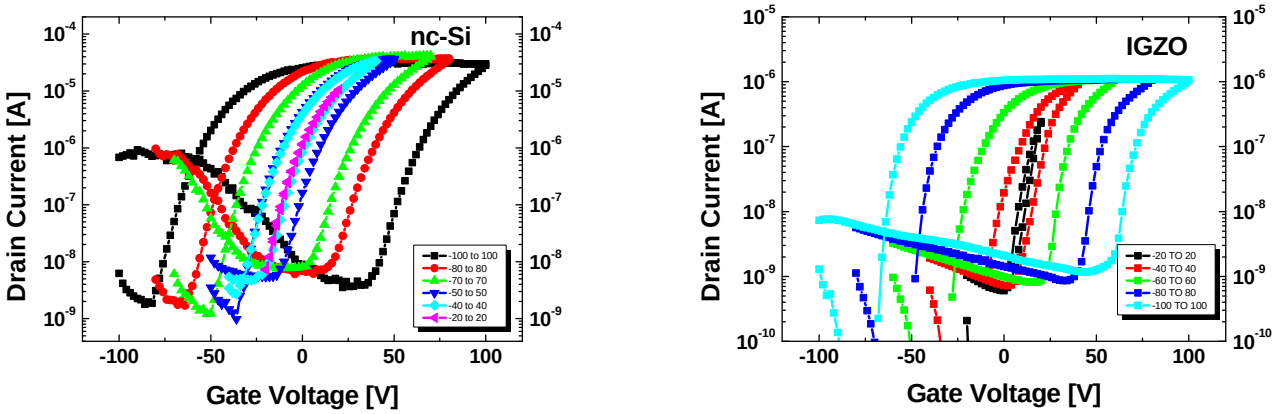
We demonstrated the nonvolatile memory functionality of both nano-crystalline silicon (nc-Si) and amorphous indium gallium zinc oxide field effect transistors (FETs) using mobile protons that are generated by very short time (within 5 minutes) hydrogen neutral beam (H-NB) treatment at room temperature (25 °C). Some researches try to hydrogen insertion process via long time (40 minutes) high-pressure hydrogen annealing (HPHA) at high temperature (400 °C) that also need several steps such as poly silicon deposition, HPHA process, and poly silicon etching process[1]. However our hydrogen insertion process does not need any other additional process but only H-NB process during normal thin film transistor fabrication. Also the whole memory fabrication process kept under 50 °C (except SiO_2 deposition process; 300 °C). These nc-Si devices exhibited reproducible hysteresis, reversible switching, and nonvolatile memory behaviors in comparison with those of the conventional FET devices. Our study will further provide a useful route of creating memory functionality and incorporating proton-based storage elements onto a probability of next generation flexible memorable electronics such as low power consumption flexible display panel.



(a) (b)

Fig. 1. (a) nc-Si base and (b) IGZO base nonvolatile memory functionality: gate bias dependent hysteresis

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References

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