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Organic-Inorganic Nanohybrid Structure for Flexible Nonvolatile Memory Thin-Film Transistor

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The Nano-Floating Gate Memory(NFGM) devices with ZnO:Cu thin film embedded in Al2O3 and AlOx-SAOL were fabricated and the electrical characteristics were evaluated.

To further improve the scaling and to increase the program/erase speed, the high-k dielectric with a large barrier height such as Al2O3 can also act alternatively as a blocking layer for high-speed flash memory device application.

The Al2O3 layer and AlOx-SAOL were deposited by MLD system and ZnO:Cu films were deposited by ALD system. The tunneling layer which is consisted of AlOx-SAOL were sequentially deposited at 100^{o}C.

The floating gate is consisted of ZnO films, which are doped with copper. The floating gate of ZnO:Cu films was used for charge trap. The same as tunneling layer, floating gate were sequentially deposited at 100^{o}C.

By using ALD process, we could control the proportion of Cu doping in charge trap layer and observe the memory characteristic of Cu doping ratio. Also, we could control and observe the memory property which is followed by tunneling layer thickness.

The thickness of ZnO:Cu films was measured by Transmission Electron Microscopy. XPS analysis was performed to determine the composition of the ZnO:Cu film deposited by ALD process.

A significant threshold voltage shift of fabricated floating gate memory devices was obtained due to the charging effects of ZnO:Cu films and the memory windows was about 13V. The feasibility of ZnO:Cu films deposited between Al2O3 and AlOx-SAOL for NFGM device application was also showed.

We applied our ZnO:Cu memory to thin film transistor and evaluate the electrical property. The structure of our memory thin film transistor is consisted of all organic-inorganic hybrid structure. Then, we expect that our film could be applied to high-performance flexible device.

Keywords: Memory Thin-Film Transistor