DEVELOPMENT OF AN ITO-BASED FERRO-ELECTRICAL MOSFET

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Introduction

Ferro-electrical field effect transistors (FeFETs) offer the potential of ultra-low energy resistive switching and high scalability. In this paper we report on the development of an InSnOx (ITO) based floating gate FeFET (FeMFET). The ITO in this study is semi-metallic, however, still show a significant current/voltage shift as the ferroelectrical HfZrOx (HZO) is programmed, allowing a relevant study of the electrical characteristics of the material stack.

Methods

The top and bottom-electrodes (TE and BE) TiN are deposited by reactive N2 sputtering. ALD and annealing of the HZO is performed directly after the BE deposition. The TE is then deposited and etched prior to a second ALD of HfOx. Following that, the ITO film is deposited with reactive O2 sputtering. The ITO is localized by wet-etching, followed by dry-etching of the high-k stack and the BE film, resulting in the structure shown in Figure 1a. Ni/Au is evaporated to form the ITO contacts and the final structure is shown in figure 1b and 1c.

Results

In figure 2a, the extracted ferro-electrical polarization charge of a capacitive disc fabricated alongside the FeMFETs is shown. In figure 2b, a drain current (ID) hysteresis loop is shown for ± 2.5 V applied gate voltage (VGS), at a drain-to-source voltage (VDS) of 100 mV. In figure 2c, the voltage memory window (MW) for 1M switches is shown.

Conclusion

We have demonstrated an ITO-based FeMFET that is successfully switched for 1M cycles. The results indicate the potential for an implementation using non-degenerate ITO.