強誘電体 HfO_2-ZrO_2 ゲート透明 $InSnZnO_x$ 薄膜メモリー

Ferroelectric HfO_2-ZrO_2 Gated Transparent $InSnZnO_x$ Thin Film Memories

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Transparent thin film memory devices are expected as necessary parts for next-generation transparent electronics. In 2011, Lee and Tokumitsu *et al.* [1] demonstrated transparent ferroelectric TFTs using P(VDF-TrFE) as the ferroelectric layer and amorphous In-Ga-Zn-O (a-IGZO) as the channel. Although the device showed a very large memory window and on-to-off current ratio, the deposition process of the P(VDF-TrFE) was not well matched for the practical device fabrication. Recently, HfO_2-ZrO_2 (HZO) [2] is a popular ferroelectric material because it shows ferroelectricity even though the film is extremely thin (~10 nm). There are several reports on a-IGZO-based FeTFTs using HZO as a ferroelectric layer. However, most researchers used TiN on Si substrate as the gate electrode, therefore, the FeTFTs are not transparent. Here, we show the fabrication and characterization of transparent FeTFTs using $InSnZnO_x$ (ITZO) [3] as the channel layer. We deposited a 20-nm-thick HZO layer on an ITO-coated alkali-free glass substrate (Corning® EAGLE XG®) by the ALD method. Then, we deposited a 10-nm-thick ITZO channel and a 30-nm-thick ITO electrode by the PLD method. After the film deposition, the devices were annealed at 300 °C in air for 10 min. The resultant transparent FeTFTs showed clear anticlockwise hysteresis with a memory window of ~0.2 V (**Fig. a**). We measured the thermopower of the channel during/after a gate voltage application and confirmed the carrier accumulation after the gate voltage application. Since the present ITZO-based FeTFT exhibits high mobility, it would be an excellent device for the next-generation transparent electronics.

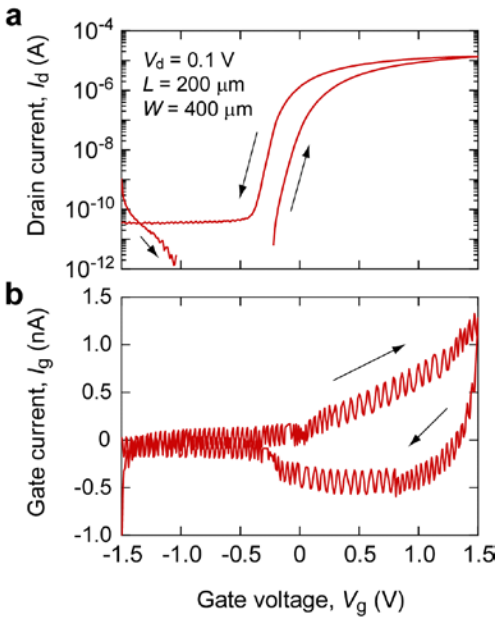

Figure | (a) Typical transfer characteristic curve and (b) gate current of the resultant ITZO-FeTFT. Anticlockwise hysteresis with memory window of 0.2 V is clearly seen in (a).

References

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[2] J. Müller *et al.*, *Nano Lett.* **12**, 4318 (2012).

[3] H. Yang *et al.*, *ACS Appl. Electron. Mater.* **4**, 5081 (2022).