Applications of Multi-Value Field Effect Transistor with Transition Metal Dichalcogenide and InGaZnO channel

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Abstract
Many of two dimensional (2D) transition metal dichalcogenide (TMD) semiconductors and related electronic devices have extensively been studied for decades. Among several types of devices, field effect transistors (FETs) with 2D channels must be the most important. Based on such p- and n-channel FETs, complementary metal oxide semiconductor (CMOS) inverters have also been reported. PN and Schottky junction diodes have been reported for their photo and gas sensing applications as well as for electrical rectifications. In the present study, we present a unique device which is combin-ing TMD FET and IGZO FET: multi-value (MV) FETs and MV inverters. For these de-vices, we have initially fabricated n-IGZO channel FET on glass substrate, which is followed by n-channel TMD (n-ReSe2, n-WSe2 and n-MoTe2) FETs. Since we use a long metal gate pattern, our n-channel TMD and n-IGZO channels share a common gate as prepared on atomic layer deposited (ALD) Al2O3 dielectric which was deposited on the patterned back gate. According to individual transfer characteristics of two devices, our n-IGZO FET always shows higher drain current (ID) and threshold voltage (Vth) than those of n-TMD channel FETs. As a result, a combined transfer characteristics presented two-step drain current levels, so that their load-resistance inverter might demonstrate two value output voltage signals. In addi-tion, our inverter devices with n-IGZO/n-ReSe2 or n-IGZO/n-WSe2 combination re-spond to visible/near infrared (IR) photons We thus regard that our unique multi-value devices using different Vth/ID properties be-tween n-TMD FET and n-IGZO FET are novel and practical enough to be worth re-port in prospective of nanoelectronics.

References

Figures

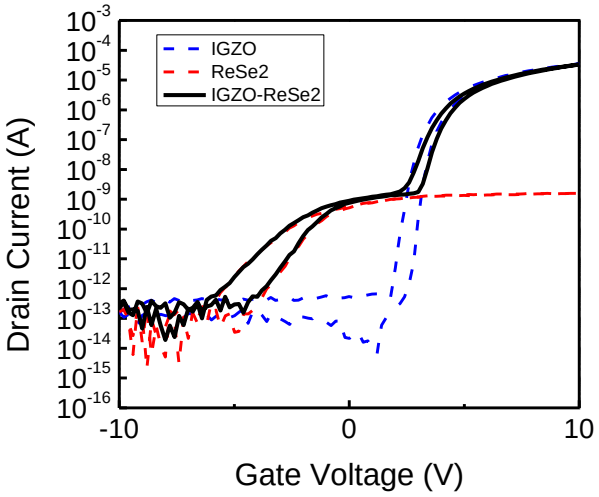

Figure 1: Transfer Characteristic of MV FET with ReSe2 and IGZO channel. Blue and red dashed curves show each property of IGZO and ReSe2 FET. Black line was measured by connecting the source of each FET and drain of each FET