High-performance ZnO/ZnMgO FET using a hetero-MIS structure

SHIGEHIKO SASA, Osaka Institute of Technology, MASASHI OZAKI, KAZUTO KOIKE, MITSUAKI YANO, MASATAKA INOUE — We propose a new structure of ZnO/ZnMgO field-effect transistors (FETs) for simplifying the fabrication process as well as for the improvement of the FET characteristics. Recently, we developed a ZnO/ZnMgO heterostructure FET (HFET) by utilizing a two-dimensional electron gas channel layer formed in the selectively-doped single quantum well structure.\(^1\) In the HFET fabrication process, the ohmic contact formation is crucial because of the difficulty in removing the top ZnMgO barrier layer with the underlying ZnO channel remained. The use of a very thin (1-2 nm) ZnMgO top barrier layer enables the formations of both good ohmic contacts without the ZnMgO etching and the gate electrode. We used metal-insulator semiconductor (MIS) gate structure with the use of a 50-nm-thick Al\(_2\)O\(_3\) gate insulator. The thin ZnMgO barrier acts as a setback layer for the channel electrons from the ZnMgO/Al\(_2\)O\(_3\) interface. The 1-μm-gate device showed a complete FET operation with a transconductance of as high as 28 mS/mm and the effective mobility of 62 cm\(^2\)/Vs. \(^1\) K. Koike et al., Appl. Phys. Lett. \textbf{87}, 112106 (2005).

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