Comparative Study of AlGaN/GaN HEMTs with and without the Buffer on SiC Substrates

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Abstract

Buffer-trapping is one of the major issues of the existing gallium nitride (GaN) high electron mobility transistor (HEMT) technology. Due to the buffer trapping the electron mobility can be severely affected in the two-dimensional electron gas (2DEG), so it degrades the device's performance. The buffer needs to be highly insulating, thick enough and has to incorporate a deep acceptor usually C or Fe doped in order to reduce the leakage current, minimize the growth defects and improve the breakdown voltage. Recently, a buffer-free epitaxial layer for AlGaN/GaN HEMTs was proposed by epi-grower SweGaN. A thin undoped GaN buffer layer in conjunction with a high-quality aluminium nitride (AlN) nucleation layer acting as a back-barrier without affecting the properties of 2DEG. In this work, a comparison between a standard device structure and a buffer-free GaN device structure, grown on silicon carbide (SiC) wafers from two different manufacturers is presented and is shown in Figure 1(a) and (b). The IV characteristics of two finger devices that have gate widths of 50 µm and gate length of 2 µm show that devices made on GaN buffer-free structure exhibit a high current density of 698 mA/mm compared to 455 mA/mm on standard GaN structure wafer. The contact resistance on both samples was similar, around 0.6 Ω-mm. This result demonstrates the potential of buffer-free GaN structure for the development of high performance high-frequency GaN HEMTs. More results from this study will be presented at the conference.

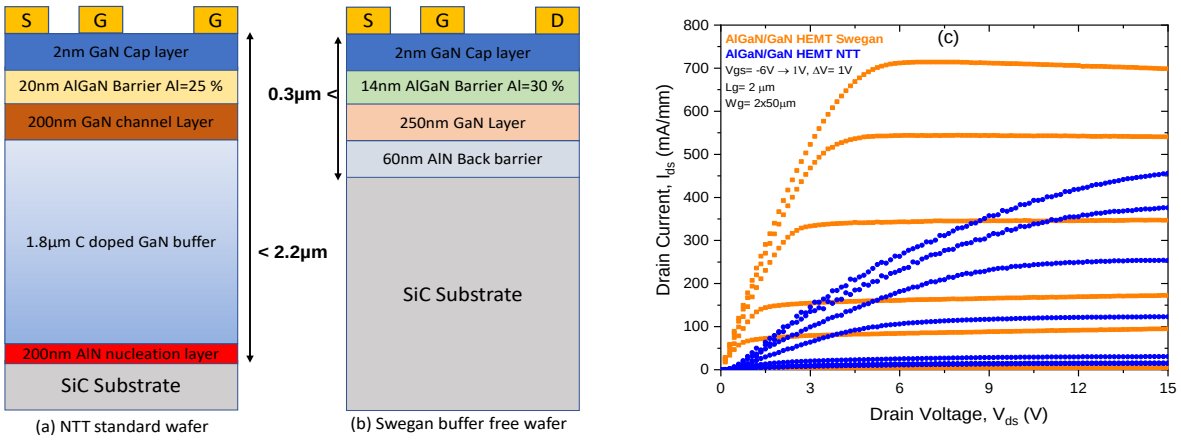

Figure1. The epitaxial layer HEMT structure of (a) a standard commercial wafer (b) Swegan buffer-free wafer (c) The comparison of I-V characteristics of AlGaN/GaN HEMTs of 50-micron wide devices.