Towards Lateral and Vertical Ga_2O_3 Transistors for High Voltage Power Switching

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Gallium Oxide (Ga_2O_3) power switching devices are expected to boost efficiency of power converters predominately operating at comparatively high bias voltage levels in the kV range. Thanks to the extraordinarily high energy band gap of 4.9 eV a high device breakdown strength of about 8 MV/cm is expected. Thus it is possible to efficiently utilize these properties for very compact power devices with aggressively minimized gate to drain separation. This enables low resistive on-state and low leakage off-state properties. Most Ga_2O_3 devices introduced so far rely on volume electron transport properties; only a few 2DEG devices have been demonstrated. In any case the values of electron mobility and saturation velocity in Ga_2O_3 crystals may depend on crystal orientation and did not yet reach properties being comparable to more developed wide band gap semiconductor families such as GaN and SiC. – Nevertheless the benefit of Ga_2O_3 devices relates to the combination of high breakdown field and electron transport properties and the resulting compact device design strategies are already getting competitive to existing power switching technologies.

The presentation will give an overview on the current status of lateral and vertical Ga_2O_3 devices with a special emphasis on device technology [1], breakdown analysis [2] and dynamic properties [3]. For both device types concepts for epitaxial layer structures and device designs suitable for reaching the targeted performance will be discussed especially in terms of breakdown voltage and channel current density. The figures below show cross sections of the principal lateral and vertical Ga_2O_3 device concepts along with important critical points for further device optimization.

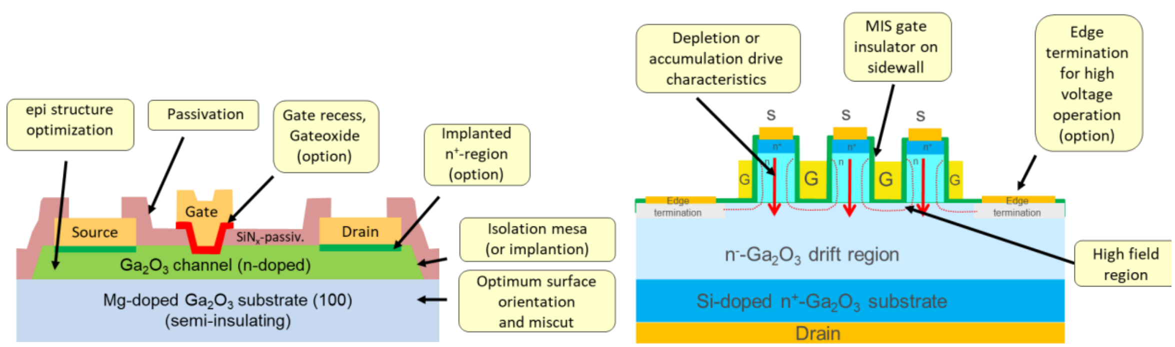

Figure 1: Schematic cross section and possible points of optimization for lateral (left) and vertical devices (right)

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[1] K. Tetzner et al., IEEE Electron Device Letters, vol. 40, No. 9, (2019), pp. 1503 - 1506.
[2] K. Tetzner et al., Microelectronics Reliability, vol. 114, (2020), pp. 113951.
[3] C. Kuring et al., Workshop on Wide Bandgap Power Devices and Applications, (2021), pp. 52-57.