Supplementary Document

A. Thermal runaway

3D electrothermal simulation is performed to determine the self-heating in a single fin of a SLCFET as shown in Fig. A(1). Initially, ATLAS simulation is performed on a single fin at the bias of V_{DS}=15 V and V_{GS}=- 5 V on a fin width of λ nm. Based on this model, the field is concentrated within 200 nm of the drain edge of the gate in this semi-ON state (Fig. A(2)). Volumetric Joule heating is applied in the ANSYS model to a 200 nm long block in the channel at this location. This is based on the model used by Middleton et al (https://doi.org/10.1109/LED.2019.2929424). The power dissipation in the single fin, obtained from experiemental I_D=50 µA at V_{DS}=15 V, is 0.7 mW which translated to peak temperature of 283 °C. This temperaure is much lower than those reported in the literature for GaN HEMTs in safe operating regime[30- 32,42]. Hence, thermal runaway causing sharp subthreshold slope can be ignored.

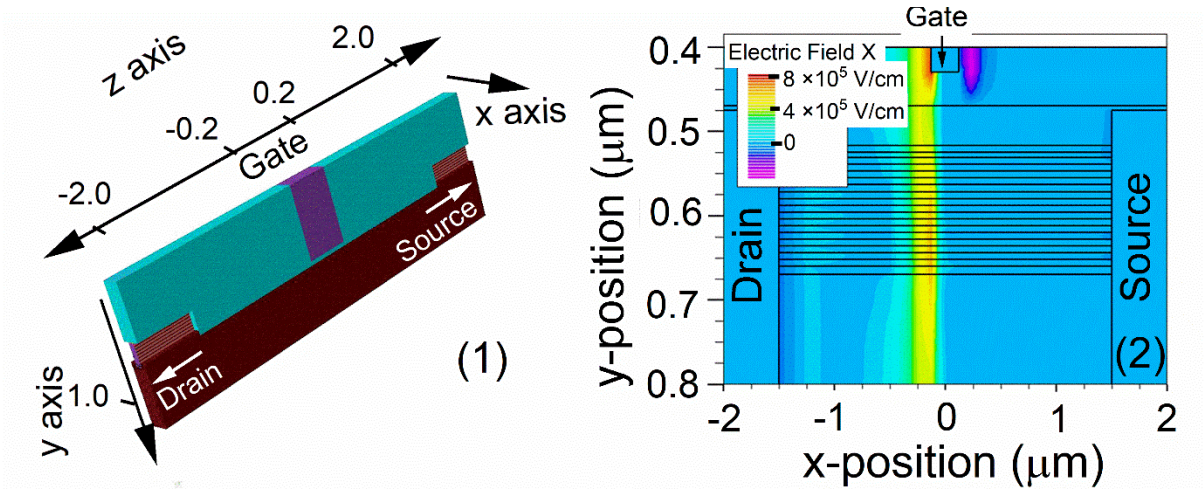

Fig. A(1). 3D schemtics of the device used for ATLAS simulation, (2) Electric field along an x-y plane at the drain end of gate.

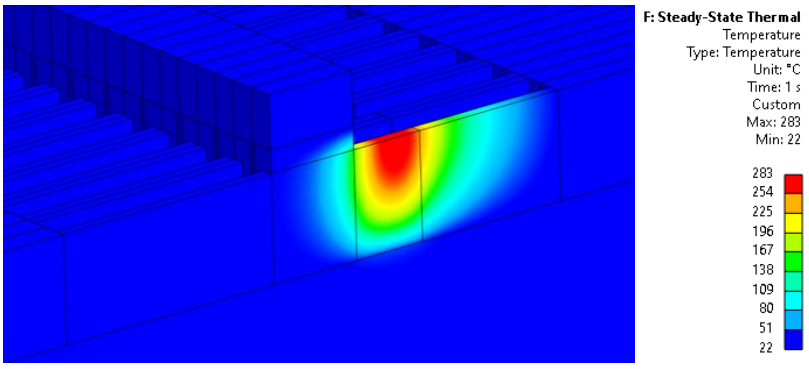

Fig. A(2). Temperature countour of self-heating of a single fin obtained from ANSYS.