Impact of Gamma Radiations on the RF performance of GaN HEMT

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GaN based devices have been the center of attraction in the past decades for high power RF applications. The strong covalence bond between Ga and N atoms makes these devices promising for space applications. Several studies have been reported for gamma-ray induced effects in GaN based devices, O. Aktas *et al.* [1] have observed a 3% increment in transconductance of device for 600Mrads dose of ^{60}Co, whereas radiation hardness of the device has been observed for large gate length HEMTs by Gill *et al.* [2]. This work investigates the change in RF characteristics of AlGaN/GaN HEMT with and without passivation layer post γ-ray exposure. The data has been adapted from the work by A. Visvkarma *et al.* [3], and the simulations, carried out in Silvaco's VictoryDevice.

Figure 1 (a) and (b) shows the device schematic and TCAD calibrated data for pristine and post radiation. The device is analyzed for high power RF applications at a frequency of 3 GHz. To analyze the efficacy of the devices for RF applications, class AB operation is considered to achieve better efficiency at the cost of linearity. Accordingly, the drain current has been set to 100 mA/mm with a fixed drain bias (V_{DS}) of 28V. The device reports a significant output power of 2.56 W/mm for passivated device structure, whereas the P_{out} increases to 2.81 W/mm for the unpassivated device, which can be linked to the crystal reordering post the gamma exposure, increasing the drain current [3], which in turn increases output power of the device, as illustrated in Fig. 1(c). Furthermore, the variations in Total Harmonic Distortions (THD) have been analyzed for passivated and unpassivated device. A lower THD has been observed for the unpassivated device post the γ – ray exposure, pointing towards an improvement in the device linearity. This improvement in the THD can be linked to the annealing of the buffer traps post the γ – exposure.

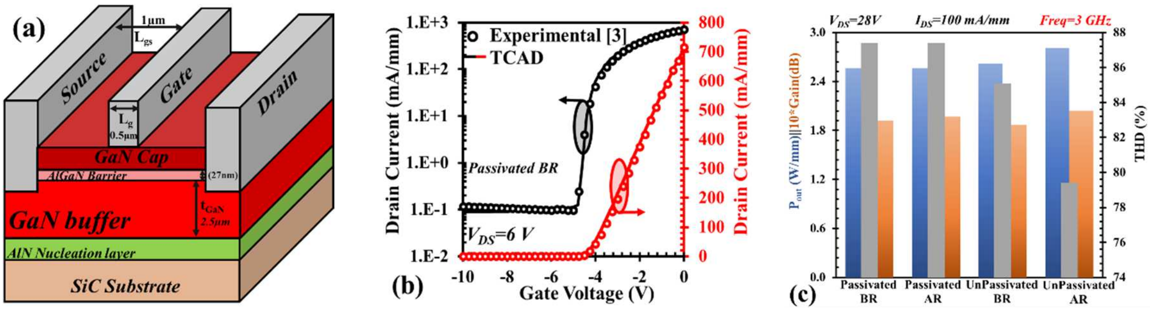

Figure 1. (a) Device Schematic of AlGaN/GaN HEMT (b) Calibrated data (IV characteristics)*[3]* (c) Variation in output power for different devices pre and post radiation. [BR: Before Radiation | AR: After Radation].

References:

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