Short-term reliability assessment of sub-micron thick AlN/GaN-on-Silicon HEMTs grown by MBE for RF applications

Elodie Carneiro[1,2], Lyes Ben Hammou[1], Stéphanie Rennesson[2], Etienne Okada[1], Fabrice Semond[2,3], Farid Medjdoub[1]

[1] CNRS-IEMN, Av. Poincare, 59650 Villeneuve d'Ascq, France, [2] EasyGaN SAS, Rue Bernard Grégory 06560 Sophia Antipolis, France, [3] Université Côte d'Azur, CNRS, CRHEA, rue Bernard Grégory, 06905 Sophia Antipolis, France

In this work, a submicron thick AlN/GaN-on-Silicon HEMT structure for high frequency power RF applications is reported. Using molecular beam epitaxy, an ultrathin step-graded buffer with a total stack thickness of 450 nm enables to combine an excellent electron confinement as reflected by a low drain-induced barrier lowering (DIBL) < 50 mV/V, a low leakage current around 10 μA/mm and low trapping effects up to a drain bias VDS = 30 V while using a 100 nm gate length.

Short-term high temperature lifetime operation (HTOL) at high junction temperature during 8-hours RF stress were carried out at a chuck temperature of 150°C, VDS =20 V and ID = 230 mA/mm. Under such a severe stress test, an extremely low drop of output power and PAE are observed with no failure. Despite the proximity of the dislocation density at the substrate interface, no increase of the current collapse is observed after the RF stress. The results demonstrate promising RF reliability and potentially stable ultrathin AlN/GaN-on-Si HEMTs under high-power operation.