

Preindustrial GaN devices developed at the nanofabrication center of IEMN

K. Harrouche, W. Rili, E. Carneiro, J. Mehta, I. Abid, and [F. Medjdoub](mailto:farid.medjdoub@iemn.fr)
farid.medjdoub@iemn.fr

Univ. Lille, CNRS, Centrale Lille, Univ. Polytechnique Hauts-de-France, UMR 8520 - IEMN - Institut d'Electronique de Microélectronique et de Nanotechnologie, F-59000 Lille, France

In recent years, wide-bandgap power semiconductors such as SiC and GaN have been receiving much attention as the "Next Generation Power Semiconductors". Since these power semiconductors have significantly lower power loss, higher breakdown fields and saturation velocities as compared to silicon-based devices, the related power devices can improve efficiency of the power supply, operate at high frequency while reducing the system size. At the same time, GaN also has excellent electromechanical properties, such as high acoustic velocities and low elastic losses. Together with a strong piezoelectric coupling, these qualities make GaN ideal for RF MEMS resonators. Hence, GaN technology offers a platform for the seamless integration of low-loss, piezoelectric RF MEMS resonators with high power, high frequency electronics. Furthermore, it can be pointed out that GaN material can also tolerate large variations of temperature and humidity as compared to metal-oxides, which is highly desired for sensing applications or MEMS in harsh environment [1].

In this presentation, we will describe two GaN technologies for RF and power applications that have been developed within the nanofabrication center of IEMN in France through partnerships with industrials. Both technologies show state-of-the-art performance while reaching a TRL 4 (Technology Readiness Level) owing to the implementation of a shared processing with foundries (Fig. 1). Innovative key active devices are fabricated in the academic environment whereas passives elements and backend were carried out by a foundry.

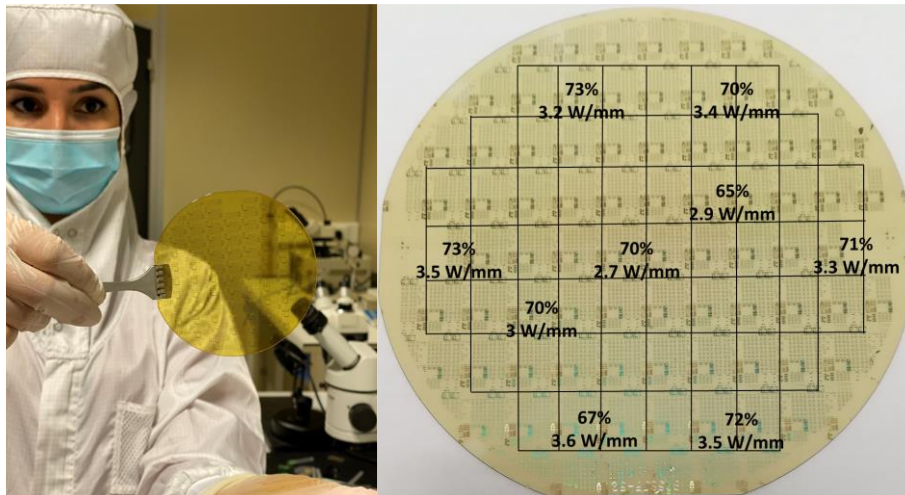


Fig. 1. 4-inch AlN/GaN-on-SiC wafer with state-of-the-art power-added-efficiency at 40 GHz. Active devices were processed at IEMN while passives elements and backend were carried out by a foundry.

[1] "Self-Temperature-Compensated GaN MEMS Resonators through Strain Engineering up to 600 K". IEEE International Electron Devices Meeting, Session 26, December 16, 2020

[2] High Performance and Highly Robust AlN/GaN HEMTs for Millimeter-Wave Operation, K. Harrouche, R. Kabouche, E. Okada, and F. Medjdoub, IEEE J. of the Elec. Devices Soc., Vol. 7, 2019