

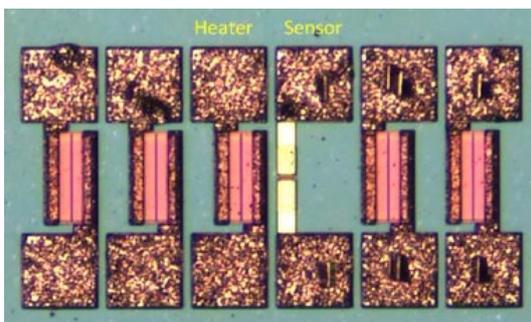
Improving thermal management for next generation of European microwave GaN technologies

Project partners: Chalmers University of Technology, Ericsson, Infineon Technologies, Keysight Technologies, Saab, United Monolithic Semiconductors

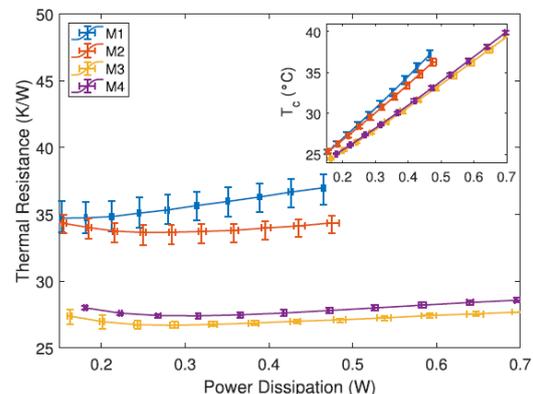
The GaN technology has revolutionized the industry with improved power density, wider bandwidths, and higher efficiency. However, the very high power density can lead to higher operating temperatures, and hence a risk of reduced reliability if not accounted for. Moreover, the high frequency performance is achieved by reduction of active device sizing and implementation of changes in GaN epitaxy structures. Therefore, this continuous development of GaN technologies requires fast and reliable verification methods of device thermal properties and thermal management. In addition, direct measurement of the chip temperature of power amplifiers operating in a system can open up for new compensation algorithms.

The close collaboration between Chalmers and European GaN industries during the last years within the GHz Centre has led to development of test structures [1], temperature sensors [2], as well as characterization methods that can separate electrical from thermal memory effects [3], [4]. The development of test structures as well as methods has resulted in that we today early on in the technology development can perform accurate analysis of the thermal management as well as dynamic response of new epitaxial designs [3], [4]. Furthermore, we have developed small temperature sensors for integration in new power amplifiers for real time monitoring of the operating temperature.

These activities improve the European GaN technologies, and make sure that European industries relying on this technology will continue to be competitive on a global market.



Novel test structure for evaluation of thermal properties, now integrated in engineering mask-sets at GHz Centre partners.



Thermal resistance evaluation without impact of trapping effects of next generation of GaN for Europe.

- [1] J. Bremer, N. Rorsman, and M. Thorsell, "A Novel Test Structure for Electrothermal Assessment of GaN Technologies," in 9th Wide Bandgap Semiconductors and Components Workshop, 2018, vol. 1, no. October, pp. 1–5.
- [2] J. Bremer et al., "Analysis of Lateral Thermal Coupling for GaN MMIC Technologies," IEEE Trans. Microw. Theory Tech., vol. 66, no. 10, pp. 4430–4438, Oct. 2018.
- [3] O. Axelsson et al., "Application Relevant Evaluation of Trapping Effects in AlGaN/GaN HEMTs With Fe-Doped Buffer," IEEE Trans. Electron Devices, vol. 63, no. 1, pp. 326–332, Jan. 2016.
- [4] J. Bremer et al., "Electric-Based Thermal Characterization of GaN Technologies Affected by Trapping Effects," IEEE Trans. Electron Devices, vol. 67, no. 5, pp. 1952–1958, May 2020.