Postdoctoral Position

Study of the Impact of Current Peaks on the Reliability of Power GaN HEMTs

Context

This postdoctoral study will take place in a dynamic and multidisciplinary environment, as part of the IPCEI PWEVTF project in collaboration with the GANRET (Gallium Nitride Reliability for Transport) project at IRT Saint Exupéry. The objective of the project is to enable the insertion of GaN-based power electronics in applications with severe environmental constraints. GANRET brings together several partners in different fields ranging from space (ADS, Safran Electronics & Defense, TAS) to aeronautics with (Safran Electronics & Defense, Safran Tech and AIRBUS), including automobiles with Vitesco Technology.
Industrial needs are complemented by a rich ecosystem of academic laboratories of expertise and technological testing and investigation facilities. The project notably integrates the cutting-edge national scientific offering represented by four public laboratories (AMPERE in Lyon, IES in Montpellier, LAAS in Toulouse, SATIE in Paris) and a private academic laboratory (ICAM in Toulouse). In practice, the job will take place in Ampere Laboratory at INSA Lyon.

Scientific Targets

The study of the impact of current peaks on the reliability of HEMT GaN power components has already been undertaken in the context of pulsed power applications [1] and more recently power converter applications [2].
These publications show degradations of the on-state resistance RON and the leakage current as a function of the number of peaks.

A circuit very similar to UIS (Unclamped Inductive Switching) is used to apply the stresses. Also, the bench developed at the Ampere laboratory for the thesis on the study of the impact of voltage peaks on the reliability of power HEMT GaN components can be used.

Likewise, the UIS circuit has the disadvantage of almost permanently applying a voltage across the component which is well known to degrade the on-state resistance in particular because of the trapping and detrapping phenomena in the vicinity of the 2DEG channel of the Power HEMT [3]. We can therefore consider using other circuit variants such as the Double Source Test (DST) [4] which allows us not to apply a voltage across the DUT most of the time.

Job Goals

The main objective will be to study the impact of current peaks on the aging of GaN HEMT power components by trying to decouple the role of the applied voltage on the degradation of the RON. The value of the current peak and its duration will naturally be stressors to study.

The work will naturally begin with a bibliographical study.

Candidate Profile

The candidate must have a thesis in the field of power electronics, or wide bandgap power devices, or even in the field of materials.

Experience in wide-band gap power components or power electronics measurements will be appreciated.

Contact

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References

[1] RAY, William B., KIM, Matthew, BILBAO, Argenis, *et al.* Analysis on repetitive pulsed overcurrent operation of GaN power transistors. In : *2016 IEEE 4th Workshop on Wide Bandgap Power Devices and Applications (WiPDA)*. IEEE, 2016. p. 353-356.

[2] SHI, Yijun, CHEN, Wanjun, CUI, Xingtao, *et al.* Investigation on the long-term reliability of high-voltage p-GaN HEMT by repetitively transient overcurrent. *IEEE Transactions on Electron Devices*, 2018, vol. 65, no 12, p. 5322-5328.

[3] MENEGHINI, Matteo, DE SANTI, Carlo, ABID, Idriss, *et al.* GaN-based power devices: Physics, reliability, and perspectives. *Journal of Applied Physics*, 2021, vol. 130, no 18.

[4] BADE, Tamiris Grossl, ALAM, Maroun, MOREL, Hervé, *et al.* Application of the Double Source Switching Test to GaN HEMTs. In : *2023 25th European Conference on Power Electronics and Applications (EPE'23 ECCE Europe)*. IEEE, 2023. p. 1-7.