Postdoctoral position on microelectronics:

Physical failure analysis of MOSFET SiC transistors under ESD stress and Single Event Burnout

Context and subject: The postdoctoral position is proposed by the “Groupe de Physique des Matériaux”, GPM UMR 6634 CNRS lab, from the University of Rouen Normandy-CNRS, in the Microelectronics, Materials and Failure Research Team. The project is part of the Carnot ESP project "SiC-Ageing", the subject is the "Characterization of local electrical and mechanical modifications of the SiC chip after ageing (electrothermal ageing and irradiation)". It is being carried out in collaboration with the CRISMAT laboratory at the University of Caen.

For the transition to a climate-neutral society, many developments in microelectronics are underway to achieve "net zero" by 2050. In this context, silicon carbide (SiC) power microelectronics components are experiencing very strong growth. Predictions indicate that the market for SiC power devices will be worth over $2 billion by 2024. The advantage of SiC over silicon (Si) is its higher critical electric field, wide band gap and high thermal conductivity.

The SiC-ageing project aims to determine the local electrical and mechanical changes in silicon carbide (SiC) power transistors that have undergone accelerated ageing tests. SiC-based MOSFETs are becoming increasingly integrated in the market. In particular, they are being incorporated into power conversion devices. Nevertheless, the detailed understanding and prediction of the mechanisms of electrothermal and radiative failures (short-circuit, thermal runaway, single event burnout, etc.) are not completely mastered and still pose a problem for meeting the reliability and efficiency requirements of these devices.

The impact of accelerated ageing, simulating the life of the component in its environment, will be determined thanks to the characterization of the local properties of the active parts, i.e. at the heart of the SiC material. Electrical characterization benches available at the GPM will enable the detection of ageing and failures by varying certain key parameters (static pulsed IV measurements, saturation current Idsat, on-state resistance Rdson, transconductance Gm, gate leakage current Igss, drain leakage current Idss, capacitance measurements CV....).
SiC-ageing proposes to analyze the degradation and deterioration of the semiconductor by electrical techniques based on an Atomic Force Microscope (AFM), the experimental part concerning the AFM will be carried out in collaboration with a post-doc from the CRISMAT laboratory in Caen.
For this purpose, fine preparations of the components in the package (front or back face) are essential and will be developed within the framework of this work. It will thus be possible and necessary to locate the defects within the component by de-packaging, laser ablation or chemical etching, then by PEM photoemission microscope or by OBIRCH (Optical Beam Induced Resistance Change) techniques.

Workplace : Rouen - Saint Etienne du Rouvray - Normandy - France - Groupe de physique des matériaux UMR CNRS 6634. Access to the GPM is regulated (ZRR: restricted areas) and recruitment is subject to the favourable opinion of a request for access.

Main scientific field : Physics

Secondary scientific fields: Electronics, Materials

Keywords: SiC MOSFET, ESD stress, electrical characterization, fault location, physical failure analysis.

Duration: 12 months, start of postdoc desired on 1 October 2023

Application deadline : 31/08/2023

Employer : University of Rouen Normandy

Gross monthly salary: 2,694 euros depending on professional experience

To apply : send by email with CV and cover letter

Different missions :

- Bibliography: Analyse the physical and electrical functioning of the power SiC MOSFET, understand the physical phenomena involved during ESD and Single Burn Event type attacks.
- To analyse and master the experimental means of electrical characterisation available at the GPM, implementation on sample components. Develop and apply sample preparation methods (de-pakaging, laser ablation, chemical etching, front and rear opening, etc.) on the study components. Implement measurements by PEM and OBIRCH photon emission microscopy to locate defects.
- Implementing additional characterization by "EBIC" (Electron Beam Induced Current) to refine the preliminary analysis.
- Valorization of the work by the writing of an article or international congress

Candidate profile: Candidate with a strong academic track record and a PhD in microelectronics or/and materials, experimental skills will be highly appreciated.

Interested candidates should send a CV, a cover letter to Pr. Pascal Dherbécourt: pascal.dherbecourt@univ-rouen.fr.