Presentation

The research group on Power Semiconductor Devices operating in the Industrial Electronics Laboratory of the Department of Electrical and Information Engineering (DIEI - LEI) – University of Cassino and Southern Lazio, is very active in research dealing with modeling, simulation and experimental characterization of power semiconductor devices with a particular attention to the physical mechanisms which may cause the device failure and can affect reliability and robustness of the modern power semiconductor devices. The research interests include the operations of power devices and modules at high temperature and at the edges of their safe operating area (short circuit, overcurrent, inductive unclamped tests, etc...). The research group has also matured a broad experience in the theoretical and experimental study of Total Dose (TID) and Single Event Effects (SEE) on power semiconductor devices due to gamma, proton, neutron and heavy ion irradiations.

Facilities

DIEI-LEI laboratory houses a high-voltage test room (Fig. 1) where several equipments are hosted. Among them it is worth mentioning several versions of non destructive power semiconductor testers (ranging up to 5kA and 6.5kV) where devices or modules are tested with a protection circuit able to prevent the device failure at the occurrence of instabilities.

Fig. 1 – The high voltage test room.

Fig. 2 – Non destructive tester for power semiconductor devices at temperature ranging from -50 °C up to 200 °C.

The tests can be performed at case temperature ranging from -50°C up to 200°C thanks to a machine which is able to convey directly on the samples under test a pre-cooled/heated special fluid (Fig. 2). In such a way the components under test are brought to the desired temperature without the need of cooling/heating the whole apparatus.
The group is able to perform irradiation tests according to the international standards and has also developed new irradiation test methodologies which, together with 3D FEM simulations, permit a better understanding of device failures during irradiation experiments. The research group has access to several irradiation facilities: Tandem and Cyclotron at the INFN – LNS, Catania, SIRAD at the INFN – LNL, Legnaro, CALLIOPE (gamma rays), TAPIRO neutrons irradiation facilities at ENEA-Casaccia and Frascati Neutron Generator" – FNG at ENEA-Frascati.

Main collaborations

The research group has recently collaborated with HITACHI Rail (formerly ANSALDOBREDA) in the non destructive characterization of high power modules and the development of high efficiency power converters (rated at 30kW), with Fairchild in the study of IGBT Short Circuit and with ST-Microelectronics for the development of radiation hardened power MOSFET.

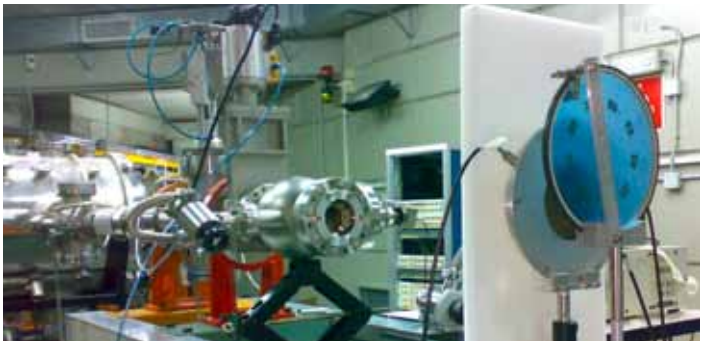

Fig. 3 – Beam line for heavy ion irradiation at the cyclotron of the Laboratori Nazionali del Sud – INFN, Catania, Italy.