

## UNIVERSITY OF BREMEN INSTITUTE FOR ELECTRICAL DRIVES, POWER ELECTRONICS, AND DEVICES (IALB)

### The Institute

The 1994 founded IALB focuses on electrical drives, mechatronics, and renewable energy (Prof. Bernd Orlik) and on power semiconductor components, their environment, and applications (Prof. Nando Kaminski, details see below). Both fields are members of the Bremen Center of Mechatronics (BCM, see [www.mechatronik-bcm.de](http://www.mechatronik-bcm.de)).

### Semiconductor Basics

Basic semiconductor physics and properties are investigated and modelled. A special focus is on alternative semiconductor materials like silicon carbide (SiC) and gallium nitride (GaN), which play an increasingly important role in power semiconductor devices. The IALB operates a deep level transient spectroscopy (DLTS) and admittance spectroscopy equipment.

### Device Concepts

The optimisation of existing components, the investigation of new concepts, and the modelling of devices are carried out by means of simulation and in cooperation with leading semiconductor manufacturers e.g. Infineon and ABB. Examples for current activities are the investigation of the RC-IGBT with respect to turn-off, snap-back, and diode behaviour as well as the investigation of a novel device concept for DC-switches. For semiconductor simulation Sentaurus of Synopsis Inc. is used, if necessary in mixed mode with circuit and thermal simulation.

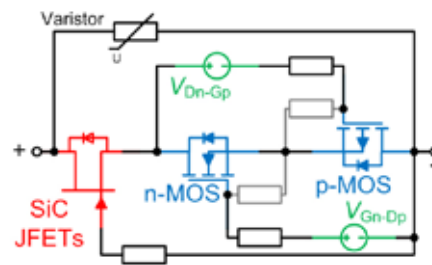


Fig.1 – Over current breaker based on the dual thyristor principle but realised with MOSFETs and a SiC JFET in cascode configuration



### Packaging and Reliability

Housing technology and cooling affect the reliability of semiconductor devices significantly. A current core activity of the IALB is the investigation of IGBT modules under humidity, temperature and high bias. Test facilities for climate and load cycling are available. Another very important aspect of the packaging is parasitics.

The determination of such components is done by means of measurement and simulation (ANSYS-Q3D by Ansoft Corp.), respectively.

### Application

The focus with respect to applications is on the interaction between circuitry and devices. One activity is IGBTs used for resonant switching. With rising switching speed and frequencies especially with SiC and GaN devices parasitics play an increasingly important role and affect the EMC-performance considerably. This is investigated by simulation and measurements e.g. double pulse testing.

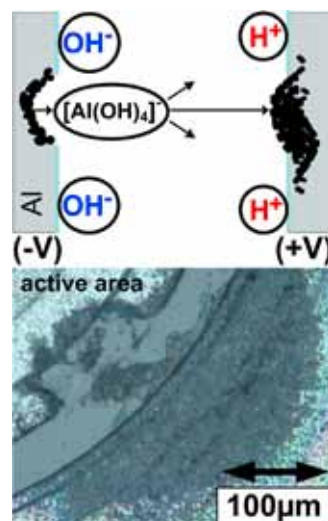


Fig.2 – Aluminium corrosion mechanism and degradation found in the failure analysis after humidity testing

