PhD in Electrical, Electronics and Communications Engineering

Research Title: Advanced models for lifetime prediction of power semiconductor modules

Funded by	Vishay Semiconductor Italiana S.p.A.

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Context of the research activity	The continuous increase of power density requirement in power electronics forces to identify advanced materials and technologies to extract the heat generated during working operation. To validate the identified solutions it is crucial the development of accelerated test methods in order to stress the components and predict device lifetime. International standards are able to define the general test categories and give guideline, but are not enough to reach a deep knowledge and understanding of the fatiguing phenomena. Starting from state of art of models for lifetime prediction, the research aims to implement a more accurate methodology able to stress under heavy power cycling conditions and get model for lifetime prediction of complex power semiconductor modules. The research will be conducted in partnership with Vishay Semiconductor Italiana that will provide the needed industrial cooperation.

Objectives	To analyze specific application (mainly in high frequency welding and Solar Inverter) and to take advantage from the study in order to identify the most recurrent destructive mechanism involving the semiconductor devices. To improve methods and conditions to be applied in order to fatigue the power modules with power cycling stress. To implement the test system and conduct runs at various conditions. To analyze results and validate the device lifetime characteristics of new generation of power modules.

	To study characteristics and performances of new materials to be used for interconnections of power chips through ultrasonic wire bonding; to develop optimized process and validate it with power cycling stress. To define a more accurate model for lifetime prediction adapted to the Vishay power modules.

Skills and competencies for the development of the activity	Background in semiconductor materials and processes. Knowledge of power-semi components.