

Multi-layer film Passivation Study for reliability performances enhancement of power semiconductor devices

Roberta Busca,^{1,2,*} Davide Cimmino^{1,2}, Sergio Ferrero¹, Fabrizio Pirri¹, Rossano Carta²,
Giovanni Richieri²

¹ *DISAT, Polytechnic University of Turin, 10123 Turin, Italy*

² *Diodes Division, Vishay Intertechnology, Inc., 10071 Borgaro Torinese, Turin, Italy*

*corresponding author: roberta.busca@vishay.com

Current automotive requirements are becoming more stringent in terms of devices operation under high-stress and harsh working conditions, such as high humidity and high temperature. In this context, passivation layers play a fundamental role in determining electrical and reliability performances^{1,2}.

This study focuses on primary and secondary passivation layers applied to state of the art power devices, and their influence on reliability. Power diodes assembled in standard module packages have been used as test vehicles and High Voltage, High Humidity, High Temperature Reverse Bias (THBHV-DC) tests were performed in order to stress the whole passivation structure³.

A complete failure mode study was performed on a selection of several passivation materials^{4,5}, involving chemical-physical resistance analysis and reliability stress techniques, leading to the comprehension of phenomena behind layers degradation.

This analysis was followed by the evaluation of different layers structure with the application of specific inorganic and organic layers combinations. In this way a summary of the typical degradation mechanisms and interactions is presented^{6,7}.

Bibliography

[1] Charalampos Papadopoulos, Chiara Corvasce, Arnost Kopta, Daniel Schneider, Gontran Pâques, Munaf Rahimo, *Microelectronics Reliability*, 88-90 (2018) 470-475.

- [2] Sebastian Kremp, Oliver Schilling, *Microelectronics Reliability*, 88-90 (2018) 447-452.
- [3] Sebastian Kremp, Oliver Schilling, Verena Müller, *9th International Conference on Integrated Power Electronics Systems (CIPS)*, Nuremberg, 2016.
- [4] Byoung-Hyoun Kim, Huijung Park, Heeyong Park, Dong Cheul Moon, *Thermochimica Acta*, 551 (2013) 184-190.
- [5] Wenjuan Chen, Wei Chen, Baoqing Zhang, Shiyong Yang, Chen-Yang Liu, *Polymer*, 109 (2017) 205-215.
- [6] Christian Zorn, Nando Kaminski, *27th International Symposium on Power Semiconductor Devices and IC's (ISPSD)*, Hong Kong, 2015.
- [7] Christian Zorn, Nando Kaminski, *8th International Conference on Integrated Power Electronic Systems (CIPS)*, Berlin, 2014.