

Popular science summary of the PhD thesis

PhD student	Ioannis Mantis
Title of the PhD thesis	Preventive measures for humidity effects on electronics
PhD school/Department	DTU Construct

Science summary

The present PhD project was supported by CELCORR and through CRECON initiatives. The work is motivated by humidity-induced failures in the electronics industry due to various corrosion modes initiated by formation of a water layer on the PCBA surface. Conformal coating is used as a preventive measure aiming to act as a barrier against moisture ingress. Corrosion mechanisms are accelerated if adhesion at the interface between polymer and substrate is insufficient.

The need for substantial understanding of the protective performance of conformal coatings on a contaminated PCBA surface against humidity-induced corrosion phenomena led the studies of this PhD work. Investigations were focused on assessment of synergistic effects between factors determining coating performance, namely: (i) coating properties such as chemistry, thickness, water-transport and adhesion, (ii) process-induced contamination from various manufacturing steps, (iii) PCBA design, and (iv) climatic exposure.

An important finding was that surface contamination is induced during process-steps prior soldering of components in the production line of PCBAs in case of improper cleaning affecting the electrochemical performance of conformal coatings under humidity exposure. Another finding was that components in the no-clean flux formulation were confirmed having an effect in the electrochemical performance of protective coatings under humidity exposure, with higher amount of activators increasing the water uptake and resin enhancing the coating performance by covering activators of the flux. The research also highlighted that the chemistry of protective coatings has a direct effect on the electrochemical performance under humidity conditions correlated with water uptake properties showing less reliance on diffusion parameters. Adhesion was elaborated as the major factor determining performance through correlation with specific chemical bonds. Another finding was that standoff height of electronic components has an effect in coating under-filling when application of coating is dependent on the viscosity, while Chemical vapor deposition (CVD) method resulted to incomplete coverage under components due to directionality of the field during application. Overall, the PhD project offered guidelines to improve both intrinsic and extrinsic robustness of PCBAs under humidity exposure. Performance of conformal coatings is interconnected with PCBA cleanliness, adhesion and water-transport properties, and design of components.

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Please email the summary to the PhD secretary at the department