Implementation of electrochemical impedance spectroscopy (EIS) for assessment of humidity induced failure mechanisms on PCBAs - DTU Orbit (13/10/2019)

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Today’s demands for steadily smaller and faster electronic devices lead to an ongoing miniaturization of electronics used in various fields. Current industry trends like e-mobility and autonomous driving are a significant motivation for this advancement. Reliability of electronics is an important aspect in all applications. In this context, particularly humidity induced failure mechanisms are of utmost importance. Temperature and humidity conditions greatly influence the durability of printed circuit board assemblies (PCBAs). The validation of humidity robustness is investigated using Surface Insulation Resistance (SIR) measurements that reveal electrochemical migration (ECM) and respectively dendrite growth. This method has several drawbacks due to its nature of direct current loading to show detailed information on water film formation and subsequent development of electrochemical failure modes. To enable the cause effect relationships of leakage current, ECM, and water film formation, Electrochemical Impedance Spectroscopy (EIS) is a promising method, since it will enable monitoring of water film formation on PCBA as a function of various parameters without perturbing electrodes due to corrosion. In this study, SIR comb structures of copper tracks on FR-4 substrates have been used for trials of a deeper understanding of EIS and a comparison with SIR measurements. The samples were exposed to climatic conditions, provoking a condensate formation on the surface. Measurements of SIR with an applied DC potential of 5 V and EIS measurements with an AC amplitude of 10 mV were conducted. The results from the EIS measurements formed the basis for electrical equivalent circuit modelling, portraying the reactions and the status of the PCB surface under changing climatic conditions and to investigate the impact of geometrical sample dimension on water film closing.

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