Corrosion in electronics: Overview of failures and countermeasures

Many field failure returns of electronics are marked as "no failure found", yet numerous of these failures are likely due to corrosion, since corrosion related failures are not easily detected during subsequent failure analysis. In some cases failures are intermittent and occur because of service life conditions (humidity and contamination) where water film formation on the printed circuit board assembly (PCBA) leads to leakage currents resulting in wrong output signal of the electronic device. If the leakage current itself will not result in malfunctioning of the electronics, the formed water film and potential bias of the PCBA will eventually lead to failure caused by more easy recognisable corrosion. Typical corrosion failure types seen in electronics are galvanic corrosion, electrochemical migration, and other types of bias induced corrosion.

This paper describes the most commonly used metals and alloys in electronic devices including aluminium, gold, copper, silver, tin, lead and their alloys. Galvanic series performed in a flux solution is presented together with examples of galvanic corrosion causing failure of electronics. Failures that find root cause in the manufacturing process are described in details, e.g. flux activator related failures. Failures caused by service life conditions with high humidity and sulphur containing gaseous environments are also described. Finally it is described how the architecture of the PCBA (the placement of components) will affect its corrosion reliability. Infrared camera imaging is used to show the thermal distribution of the PCBA during power on periods and can reveal local cold spots on the PCBA being prone to condensation and corrosion.