

## Selective Corrosion and Electrochemical Migration of Metals in Electronic Devices under High Integration Conditions

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**Abstract** As electronic products advance towards superior performance and higher integration, electronic materials, particularly solder metals, encounter complex and abnormal corrosion issues during manufacturing processes and actual service, significantly affecting product reliability. This paper begins with the study of the Sn-Ag system, using practical Sn-Ag solder alloys to investigate the corrosion and dendrite growth processes. The fundamental thermodynamic and kinetic principles involved are revealed. The mechanisms by which various factors influence selective corrosion behavior are identified, including operating voltage, temperature and humidity, pH value, and flux. Subsequently, specially designed Sn-Ag alloys were employed to further examine the critical role of intermetallic compounds such as  $\text{Ag}_3\text{Sn}$  in the selective corrosion process. Based on these findings, evaluation methods and a life prediction model for solder corrosion failure were established and applied to the study of selective corrosion in more complex ternary and quaternary multi-metal systems.

**KEY WORDS** Solder alloy; Packaging; Corrosion; Failure; Bump