International Journal of Mechanical Engineering (IJME)
ISSN(P): 2319-2240; ISSN(E): 2319-2259
Vol. 3, Issue 2, Mar 2014, 17-26

International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations

ON THE MATHEMATICAL MODELING OF COPPER DISSOLUTION AND IMC GROWTH IN LIQUID SOLDER

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ABSTRACT

Soldering is the default joining proce0073s in the electronic packaging industry. Solder joints are obtained by interaction of the substrate (mostly copper) with the molten solder. The dissolution kinetics of copper and the growth of intermetallic compound (IMC) during soldering process are concurrent processes. The dissolution of the metal from the substrate components is even more critical due to ever increasing miniaturization of the electronic components. The assessment of base metal lost during the process is another important subject being investigated by the researchers in the last two decades. Extensive experimentation is done to quantify the IMC thickness and metal dissolution for various combinations of substrate metal and solders. As a matter of fact these experiments are time consuming and expensive. Moreover, the experimental results have the application to a limited domain. Various models have been suggested by researchers to quantify the substrate thickness lost and IMC growth during soldering. Most of the existing models to estimate the IMC growth and metal dissolution during the soldering process are heavily based on the experimental data. These models do not depict the actual physics of the process. In the present study a review of the modeling techniques has been done and a model has been proposed which is based on the diffusion of and interface kinetics during soldering process. The proposed one-dimensional model has been solved and compared with the experimental data. The present model has a good potential to be extended in two and possibly three dimensions and incorporation of scalloped IMC in order to capture the complete physics of the process.

KEYWORDS: Copper Dissolution, IMC Modeling, Interface Kinetics, Lead, Free Solder, Non-Equilibrium Melting, Soldering