Electronic Packaging: Materials and Reliability Enhancement through Nanoparticle Reinforcement

A. S. M. A. Haseeb
Department of Nanomaterials and Ceramic Engineering, Bangladesh University of Engineering and Technology (BUET), Dhaka

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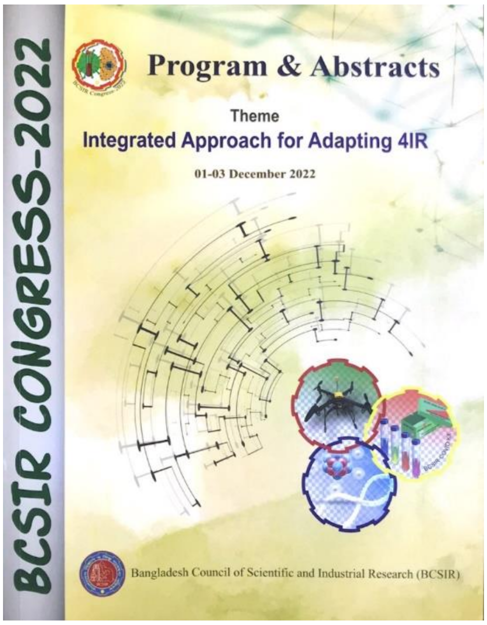
Keynote Lecture, BCSIR Congress-2022, Bangladesh Council of Scientific and Industrial Research (BCSIR), Technical Session: TS-2B (Materials and Metallurgy), 02 December 2022

Abstract



BCSIR CONGRESS-2022
Program & Abstracts
Theme
Integrated Approach for Adapting 4IR
01-03 December 2022
Bangladesh Council of Scientific and Industrial Research (BCSIR)

Electronic packaging is a vital step in the rather complex manufacturing value chain of electronic products. This step is intended to secure fragile semiconductor chips - protect them from mechanical, thermal and chemical damages, and also connect them to other components in the system. Materials used in electronic packages are critically important in determining the performance and reliability of electronic products. In the first part of this presentation, an overview of the electronic manufacturing value chain with emphasis on electronic packaging will be given. In the second part, our recent research results on the enhancement of the properties and performance of a vital component of modern electronic package, solder joint, through nanoparticle reinforcement will be described. In this research, we introduced Ni and Co nanoparticles into Sn-3%Ag-0.5%Cu (SAC 305) solder joints through flux mixing. The solder joints were investigated after reflow, aging and electromigration using optical and electron microscopy, and electron back scatter diffraction (EBSD). Mechanical properties of the joints were tested using ball shear and micro-tensile tests. The use of nanoparticle-doped flux resulted in smoother and finer grain structure of the interfacial intermetallic compound layer, as well as finer bulk microstructure. Nanoparticle doping also provided higher stability to the microstructure during electromigration. Nanoparticle-doped flux led to better resistance against brittle fracture in aged joints. A significant reduction in electromigration damage and a greater retention of tensile strength after electromigration were observed for joints prepared using Ni and Co nanoparticle-doped flux. It is suggested that Ni and Co nanoparticles underwent reactive dissolution during reflow influencing the structure and properties of the joint through in-situ alloying.