IN-SITU STUDY OF ELECTROMIGRATION INDUCED STRAIN / STRESS EVOLUTION AND DISTRIBUTION IN SN - CU LEAD-FREE SOLDER JOINTS USING SYNCHROTRON WHITE BEAM X-RAY MICRODIFFRACTION

It is well known that electromigration would induce stress gradient built up in a solder joint due to the atomic transport from cathode end to the anode end, and the stress gradient will affect the atomic diffusion as a feed back according to Blech - Herring model, however, there is no literature report on the stress distribution induced by electromigration in the solder joints so far. Here we report a direct measurement of the stress evolution and distribution in a eutectic Sn - Cu lead-free solder ball as a function of electric current stressing time at enhanced temperature by using synchrotron radiation based polychromatic X-ray microdiffraction at the early stage of electromigration test. At this stage, no significant electric resistance change was observed, while the whole solder ball was under compressive strain, and the strain level is below the elastic limit. The stress, therefore, was also calculated based on the strain and elastic constant. The stress distribution in the solder ball is explained based on the current crowding theory of electromigration.