COMPOSITION MEASUREMENTS OF SnPb SOLDER BUMP ON C4 FLIP CHIP INTERCONNECTION FOR SEMICONDUCTOR PACKAGE INDUSTRY

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Flip chip technology is a new trend in IC package industry for IC chip to carrier interconnection. Comparing with conventional package methods, such as plastic quad flat pack (QFP), surface mounted device (SMD), and Ball Grid Array (BGA), flip chip interconnection offers advantages of smaller connection size and shorter connection distances, which can result in higher chip I/O density, lower fabrication costs, and better reliability.

IBM Controlled Collapse Chip Connection (C4) flip chip process uses 97%Pb/3%Sn solder bumps with diameters ranging from 100 to 125 microns as a chip-to-carrier interconnect. As a requirement from industry, measurement standard deviation on composition of C4 Sn/Pb solder bumps has to be less than 0.1 weight percent.

Solder bump composition measurements are usually performed on a test pad. Test pad is an 8" diameter silicon wafer coated with a thin layer of under-bump metallization. The solder bumps are then applied to the wafer in a two dimensional array. Bumps have cylindrical shape with a diameter of about 100 microns and a height of about 150 microns. The spaces between bumps are from 100 to 200 microns depending on directions. The metallization is a thin layer of NiV over Ti.

Small bump size and discontinue arrangement of bump array limited fluorescence x-ray intensity available from sample. A XRF spectrometer with a large detection solid angle would be desired to achieve highest possible counts rate. The spectrometer uses a two inches diameter proportional counter witch has a detection window size of 1"x2". Varieties of combination of multi-layer foils were tested for filtration of excitation spectrum from X-ray tube to optimize counts rate. A unique primary filter consisting of five layer foils was used for increasing relative contributions of Sn K line fluorescence x-rays to total intensity. The other obstacles associated with discontinue arrangements of bump array, Compton scatter from Si substrate, and interference of under-bump metallization material were solved though a series of software approaches which include deconvolution of overlapped peaks and background removal from spectrum using orthogonal polynomials.

A major IC manufacturer tested the spectrometer. Measurement precision achieved is 0.08 weight percent. Hardware and software set up of the system will be discussed and detail test data will be presented.