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NASA TECH BRIEF

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Quality Control of Microelectronic Wire Bonds

A study was conducted to evaluate the ultrasonic bonding of small-diameter aluminum wire joined to ceramic substrates metalized with thin-film and thick-film gold. These bonds are commonly used in microcircuit fabrication in hybrid assemblies. The results of the study are published in a report.

One interesting result of this study was the development of a quick testing technique for the nondestructive location of poor wire bonds. A 00 artist's brush is used in the test to brush the lower ends of the wire bonds. Wire movement during brushing indicates a bad bond. A force exerted by less than 2 grams during the brushing is too low to damage the bonds.

The report discusses the 1-mil, 1.5-mil, and 2-mil (25.4-μm, 38.1-μm, and 50.8-μm) wire used, with the bonding metalization consisting of thick-film gold, thin-film gold, and aluminum, as well as conventional aluminum pads, on semiconductor chips. The chief tool for evaluating the performance is the double-bond pull test in conjunction with a 72-hour 150° C heat soak and a -65° to +150° C thermal cycling. In practice the thermal cycling has relatively little effect compared to the heat soak.

Results show that, in general, pull strength of the bond decreases after heat soak as a result of the annealing of the aluminum wire. When bonded to thick-film gold the pull strength of the bond decreases by about 50 percent. Even more important, weakening of the bond interface is the major cause of the reduction. Bonds to thin-film gold lose about 30 to 40 percent of their initial pull strength, but, in this case, weakening of the wire itself at the bond heel is the predominant cause. Bonds to aluminum substrate metalization lose only about 22 percent. Bonds between thick-film and thin-film gold substrate metalization and semiconductor chips substantiate the previous conclusions, but they also show that in about 20 to 25 percent of the cases bond interface failures occur at the semiconductor chip.

The report serves as an aid to quality control in microelectronic fabrication. It includes a number of illustrations showing different bonding configurations and testing equipment. Based on the new findings a more thorough quality test schedule can be developed that will result in more reliable microelectronic circuits.

Note:

Requests for further information may be made in writing to:

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Patent status:

NASA has decided not to apply for a patent.

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(MFS-23327)

Categories: 01 (Electronics - Components and Circuitry)
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