Comparison of tensile and fatigue properties of copper thin film depending on process method

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1. Introduction

As the demand for semiconductors increases, the capacity increases, and the size of electronic devices becomes smaller, the size of devices applied to FPCBs is also decreasing. Recently, a package technology that is the same as the size of a semiconductor device is required, and a chip size package is applied instead of a surface mount package, and TCP is a typical example.

Unlike TCP's reliable plastic package, the beam lead is more problematic than the solder joint that connects to the board. This is because the beam lead suddenly changes in cross-section by the bonding process and the main causes of fracture. Figure 1 is a cross-section of the TCP and shows an example of beam lead crack. Figure 2 shows an enlarged image of the actual beam lead crack.

Therefore, because it takes a lot of time to manufacture a product, accurate reliability evaluation of the material is essential before the prototype is manufactured.

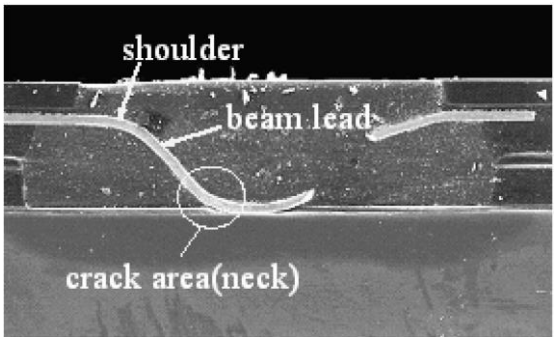

Figure 1 SEM of cross section of TCP

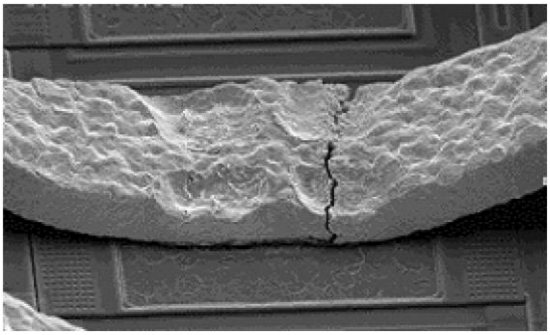

Figure 2 SEM of beam lead crack in TCP

2. Body of abstract

2.1. Design of Specimen and Tester Configuration

In order to compare the tensile and fatigue properties of the copper thin film manufactured according to the process, the test was performed by separating it into rolled and electrodeposited copper. Tensile and fatigue specimens were designed differently to obtain mechanical and fatigue properties of copper. Specimen of the tensile test designed of dog-bone type and the part of the load was composed of 5000um in and 700um in width. Although the specimen of fatigue test is different in shape of the specimen of the tensile test, the specimen is designed the same length and width dimensions. The thicknesses of the specimens were designed in the same 12um.

The tester was configured as shown in figure 4 to obtain the tensile and fatigue properties of copper. A voice-coil was used to load the specimen in tester, which enables accurate and prompt response of loading conditions. In addition, a small load cell was used and load cell can measure up to 10N and the resolution is 1.0mN. And a capacitive sensor was used to measure the displacement of the specimen. The displacement sensor can measure up to 1250μm and the resolution is accurate to 0.1μm.

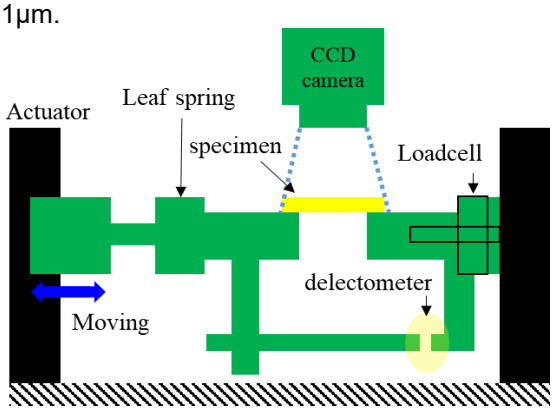

Figure 3 Mechanical Tester for tensile and fatigue test

2.2. Tensile and Fatigue Test

Tensile tests were performed to obtain the mechanical properties of the thin film, such as elastic modulus, yield strength and ultimate tensile strength. In addition, in order to obtain the fatigue properties according to the manufacturing process,

we conducted the fatigue life into four stages (10,000 / 50,000 / 100,000 / 500,000 cycles) for the rolled and the electrodeposited Cu, and at least three fatigue tests were performed and compared the each of fatigue properties

Table 1. The result of mechanical Properties depending on process method (Elastic modulus, 0.2% offset yield strength, ultimate tensile strength)

	Elastic Modulus	Yield strength (0.2% offset)	Ultimate Tensile strength
Rolled Cu	63GPa	306MPa	414MPa
Electrodeposited Cu	61GPa	233MPa	367MPa

3. Conclusion

In this study, specimens of rolled foil and electrodeposited foil were fabricated according to the copper thin film manufacturing process, and tensile test and fatigue test were performed. Experimental results can be used to evaluate the mechanical properties of thin film materials used in electronic components.

Therefore, the mechanical and fatigue characteristics obtained from the test results of the copper thin film manufacturing process are expected to be used as based data necessary for the analysis and design of the product to improve the reliability of the product.

Acknowledgment

You may include the acknowledgment if necessary.

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