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Mechanical property of ultrasonic bonded FPCB/RPCB joint with self-assembling material

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1. Abstract

As the demand for thin, light and multi-functional devices increased, the ultrasonic bonding methods has spot-lighted to novel bonding method. We evaluated the mechanical property of ultrasonic bonded joints with various conditions using self-assembling material which was Sn-58Bi solder particles dispersed in epoxy resin. After bonding process, we evaluated the mechanical and electrical properties between electrodes. The peel strength of the joints was increased with increasing of bonding time, and the resistance was decreased with increasing of bonding time.

2. Introduction

The consumers has continuously required thinner, lighter and multi-functional devices to electronics industry. As the package size had been decreased, finer pitch electrodes were employed in electronics.

Ultrasonic bonding method is well-known as suitable bonding method for fine pitch electrode between flexible printed circuit board (FPCB) and rigid circuit board (RPCB) because it had a number of advantages such as low processing time, low cost, and environmental-friendly process.[1)] Generally, ultrasonic bonding methods was applied to metal to metal interconnection or interconnection between electrodes using anisotropic conductive adhesive (ACA) and nonconductive adhesive (NCA).[2-5)] Although the ultrasonic bonding method with NCA is applied to fine pitch interconnection between electrodes, some researchers reported that ultrasonic interconnection with NCA was shown poor reliability properties.[2,6,7)]

Recently, developed self-assembling material (SAM) was reported. The SAM is a kind of conductive paste which was constructed with solder particles (Sn-58Bi) dispersed in insulation epoxy resin. The solder particles in epoxy resin was coalesced when the temperature is increased up to the solder melting point. It has a low electrical contact resistance and high thermal conductivity.[8,9)] Therefore, the SAM is employed to finer pitch interconnection using ultrasonic bonding method.

In this study, we could confirm the feasibility of applicability to finer pitch interconnection between FPCB/RPCB electrodes using ultrasonic bonding method with SAM. The characteristics of ultrasonic bonded FPCB/RPCB joint with SAM was investigated by peel test and measurement of resistance. In addition, we studied about conduction behavior through observation of microstructure of the conduction path between electrodes and fractured surface.

3. Experimental Procedure

We designed the RPCB and FPCB with daisy chain structure. The RPCB was prepared by two different surface treatments which were organic solderability preservative (OSP) and the electroless-Ni/ immersion-Au (ENIG). The surface treatment of FPCB was fixed to ENIG treatment. The pitch size and number of electrodes were 300 ㎛ and 50 ea., respectively.

The purchased self-assembling material (SAM 32-401-11, Tamura Corp,. Japan) was applied on between electrodes. The FPCB was bonded on RPCB using ultrasonic bonder (Jeil ultrasonic Corp., Korea) during 1, 2, 3, 5, 7, 10 s. The frequency of ultrasonic generator was fixed at 40kHz. **Fig. 1** showed the typical ultrasonic bonding process with SAM.

In order to investigate the mechanical property of ultrasonic bonded FPCB/RPCB joint, the 90° peel test was conducted in displacement rate of 50.8 mm/min. The bonded FPCB/RPCB interfaces and fracture surfaces were observed and analyzed using scanning electron microscopy (SEM). The electrical property was measured by two points probe method.

Curing degree of epoxy resin included in SAM was analyzed using Fourier transform infrared spectroscopy (FT-IR spectroscopy). The area of trapped solder particles in electrodes was analyzed by X-ray scope.

4. Results and Discussion

Fig. 2 shows the effect of bonding time on the peel strength of the FPCB and OSP treated RPCB joint. The peel strength between electrodes was increased with increasing of bonding time from 1 to 5s. The maximum peel strength was 4.4 N/cm at 5 s. In case of excessive bonding time (over 5 s), the FPCB was damaged by heat and pressure. Longer bonding time usually contributes

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to improve the peel strength because of increasing amount of trapped solder particles which formed mechanical and electrical connection. However, excessive bonding time caused the thermal damage to organic structures of FPCB. We will fully discuss about characteristics such as mechanical and electrical property, microstructure, and connection behavior in presentation and manuscript.

References

1. J.M. Kim, J.P. Jung, Y.N. Zhou and J.Y. Kim: J. Elect. Mater. **37** (2008) 324
2. J.B. Lee, J.M. Koo, S.M. Hong, H. Y. Shin, Y.J. Moon, J.P. Jung, C.D. Yoo and S.B. Jung: Jpn. J. Appl. Phys. **47** (2008) 4300
3. J.B. Lee, J.G. Lee, S.S. Ha and S.B. Jung: J. Adhes. Sci. Technol. **25** (2011) 2475
4. T.W. Kim, K.L. Suk and K.W. Paik: 2013 IEEE 63rd Electron. Comp. & Technol. Conf. (2013) 461
5. K.W. Lee, I.J. Saarinen, L. Pykari and K.W. Paik: IEEE Trans. Comp. Packag. Manuf. Technol. **1** (2012) 1901
6. J.B. Lee, J.G. Lee, S.S. Ha and S.B. Jung: Microelectron. Eng. **88** (2011) 715
7. G. Dou, A.S. Holmes: 2012 13th Intl. Conf. Therm. Mech. Multi-Phys. Microelectron. Microsyst. (2012)
8. J.W. Baek, K.S. Jang, Y.S. Eom, J.T. Moon, J.M.Kim and J.D. Nam: Microelctron. Eng. 87 (2010) 1968
9. K. Yasuda: IEEE Trans. Comp. Packag. Manuf. Technol. **1** (2012) 1895

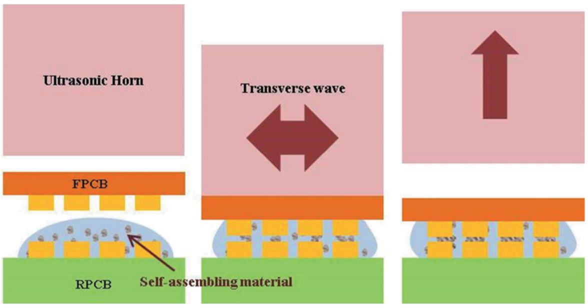

Fig. 1 Schematic diagram of typical ultrasonic bonding process using self-assembling material.

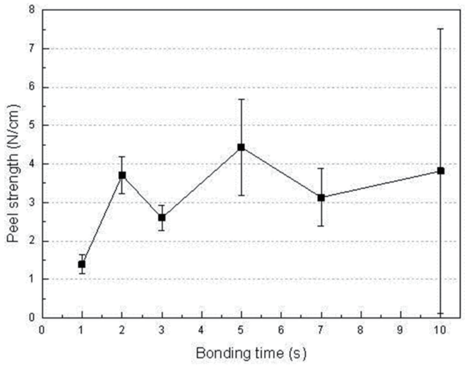

Fig. 2 Peel strength of FPCB and OSP treated RPCB ultrasonic bonded joint with increasing bonding time.