《NSC's Bonding Wire and Micro Ball》

Flexion Phenomenon is Eliminated by Looping Control and Both High Thermal-Fatigue Resistance and High Drop-Impact Strength are Realized.

The trend has developed rapidly for smaller and higher performance electronic devices. Semiconductor devices are also being developed for higher density, more pins, and higher performance. The NSC Group has also provided industries with types of bonding wire products and lead-free solder balls to meet high-density packaging technologies used in semiconductor device manufacturing.

Advanced Technology Research Laboratories (R&D) of Nippon Steel Corporation's New Materials Division and Nippon Micrometal Corporation have worked in cooperation to meet all needs of customers and address technical challenges quickly. This paper introduces the characteristics of major products and progress in product development efforts.

● High-strength and small-diameter wires applicable to narrow pitches have been developed.

"NT" series wires have been developed as a new line-up for the 4N series (>99.99%), which are the most widely used in today's market. The "NT" series features high strength and high elasticity and can be formed into various types of loops. These wires can be controlled with respect to wire transformation in the case of plastic molding, which makes it possible to use the wires to narrow pitch connections, including pitches of 40 μm or less common in state-of-the-art technologies (see Fig. 1). "NT5" wires in particular are stronger than general-purpose wires by more than 20%. Mass production of extremely thin wires of 15 μm or less, which are expected to be in demand in the next-generation connection technology after 35-μm pitches, is also possible. Furthermore, the wires are not only strong but also have almost the same properties as general-purpose wires, such as junction characteristics, loop-controllability, and electric conductivity. In short, the wires will result in excellent mass production performance using the most advanced high-speed bonding equipment.

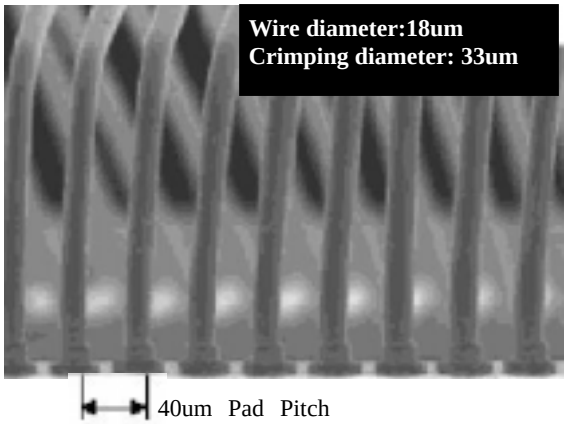

Fig. 1 40-μm Narrow Pitch Connection

●Flexion-related problems in stacked packages and the like are eliminated.

The wires used in stacked packages in which multiple chips are stacked are required to be suitable for stud bump formation and looping

control when wire connections are made on stud bumps (see Fig. 2). One of the problems in today's technology is partial bending of wires. This problem, unlike the conventional bending problem in which the entire wire bends gently, is believed to be the plastic deformation of part of the wire due to the impact caused by wire cutting. To solve the problem, we have developed the "NT6" series. With NT6, flexion defects have been eliminated by improving fracture strength and elongation property. Flexion problems have been increasingly reported in connection with the BGA package, where wire connections are made in the plated part on a substrate. NT6 series wires are attracting the attention of the industry for their excellent looping controllability.

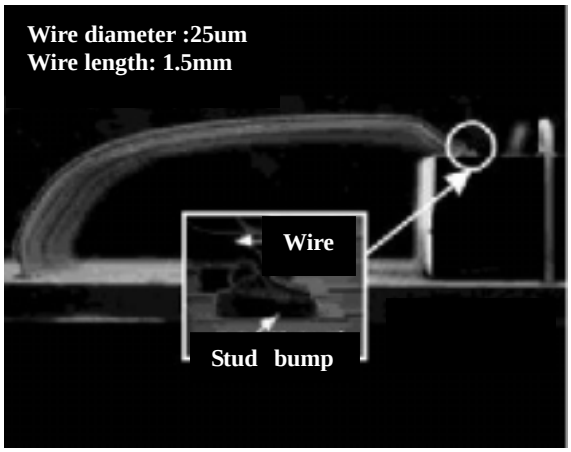

Fig. 2 Bonding Wire for Stack Junction

We have also improved wire bonding performance as well as junction reliability at high temperatures to meet the recent need for higher reliability of packages. To this end, we have and developed the 2N (>99%) series alloyed wires "R2," which feature almost the same continuous bonding capability as 4N gold wires. R2 alloyed wires can be used in mass production without changing current bonding equipment or bonding conditions. We are also developing high-reliability alloyed wires to meet strict requirements to prevent voids generated when an intermetallic compound is formed in the Au-Al junction and to prevent a corrosive reaction between the intermetallic compound and sealing resin component in a high-temperature and high-humidity environment, as in the case of vehicle-loaded ICs.

● Solder ball series have been improved and expanded.

The size of solder balls required for mobile electronic devices is rapidly decreasing these days from 500 μm in diameter to 300 μm; the dominant size will become 300 μm. When it comes to wafer technology, such as CSP (WL-CSP), solder balls of 100 μm in diameter have been used, though partially. It is certain that 100 μm will be the mainstream size in near the future. Nippon Micrometal Corporation and its group companies have been developing series of products to improve the lineup of solder balls (mainly 760–150-μm balls; 150-μm or less are custom-ordered balls).

Under the circumstances mentioned above, we have succeeded in developing the Sn-Pb eutectic soldering system "ST21," which has both thermal-fatigue resistance (see Fig. 3) and drop-impact strength, two things that have been considered incompatible. Since the coarsening of the grain structure of Pb causes thermal-fatigue cracks to develop, we felt that control of the coarsening of the Pb structure would be the key factor and developed technologies (see Fig. 4) aimed at uniform fine dispersion and fine solder crystal structure in order to realize high

thermal-fatigue resistance. In addition, we have improved the flexibility of solder balls, enhanced the strength by developing finer solder structure, and improved the stability of solder joint interface and realized high drop-impact strength.

As for the promotion of lead-free engineering to go along with environmentally conscious market trends, we have introduced a product such as the Sn-Ag-Cu, Sn-Ag, Sn-Cu, Sn-Zn, and Sn-Zn-Bi series. The low-Ag series “LF35” (Sn-1.2Ag-0.5Cu) in particular features excellent thermal-fatigue resistance and high drop-impact strength, which are highly evaluated by users. “LF24” (Sn-2.6Ag-0.6Cu) series solder balls have high thermal-fatigue resistance.

(For more information, contact us below.)

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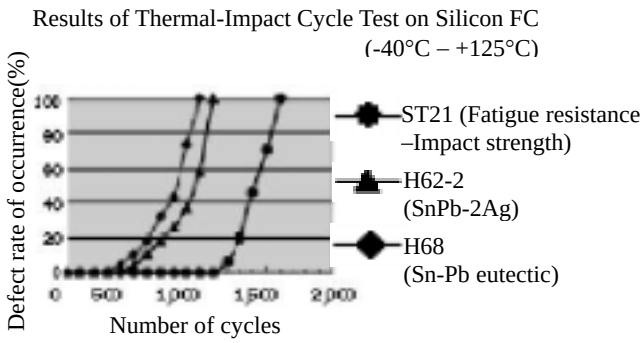

Fig. 3 Thermal-Fatigue Resistance of Solder Balls

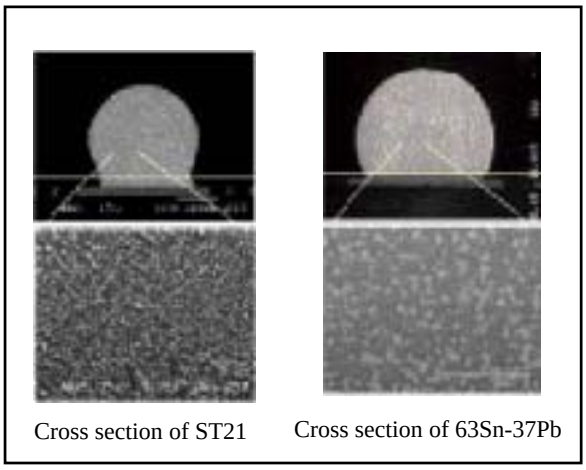

Fig. 4 Fine Structure of Solder Balls