January 18, 2023

Notice Regarding Development of Transfer Bonding Sheets
Using Copper Nanoparticles for Power Devices

The Nippon Sanso Holdings Group's Taiyo Nippon Sanso Corporation ("TNSC", President: Kenji Nagata) hereby announces that it has successfully developed transfer bonding sheets using copper nanoparticles, for use as bonding materials for automotive power devices.

1. Background

Power devices are semiconductor chips that are used in power conversion equipment such as inverters for applications such as electric vehicles. Due in part to the global shift toward electrification in the past few years, developing high-performance power devices has become critical to providing long driving ranges for electric vehicles and other next-generation vehicles. Silicon carbide (SiC) devices allow for module miniaturization and high-temperature operation, and these devices are expected to enable the development of high-performance power devices. SiC devices have already been adopted in certain vehicle models.

TNSC possesses metallic nanoparticle synthesis technology, which relies on oxygen combustion technology developed independently.

The copper nanoparticles synthesized in this process are particles (a dried powder) with a size of approx. 100 nm and are coated with a surface layer of copper oxide. Unlike particles synthesized through the typical wet process, these have no organic protective coating, so there is very little outgassing when the particles are sintered, making low-temperature sintering possible. TNSC had previously developed bonding sheets for power devices in 2020. These were formed into sheets by powder molding the copper nanoparticles. However, these powder-molded bonding sheets had stiff and brittle physical properties, raising concerns about chipping and cracking during the handling process.

2. Overview of Transfer Bonding Sheets Using Copper Nanoparticles

TNSC has developed a transfer bonding sheet using copper nanoparticles that can be transferred at the same size as bonded materials by applying heat and pressure. The bonding sheet is formed on a release film substrate and the materials to be bonded, such as SiC chips, are mounted on the bonding material.

The features of the bonding sheet are outlined as follows:

- The sheet is flexible, eliminating concerns about chipping and cracking that existed with the powder-molded bonding sheet that was previously developed by TNSC.

- Commercially available paste bonding materials are silver-based sinter bonding materials. The paste is printed on the bonding surfaces of the materials to be bonded, and after a predrying process, the surfaces are bonded by applying heat and pressure. Printing is not required using TNSC's newly developed bonding material.
- Unlike paste, the new material is a sheet with minimal organic material content, which eliminates the need for predrying. It can be bonded immediately after transfer, greatly simplifying the bonding process.
- The new material can offer a bonding pressure of 10 MPa and a high strength (shear strength of 70 MPa or more) with a bonding time of 5 minutes at a low bonding temperature of 250°C, which was previously problematic for copper-based sinter bonding materials.

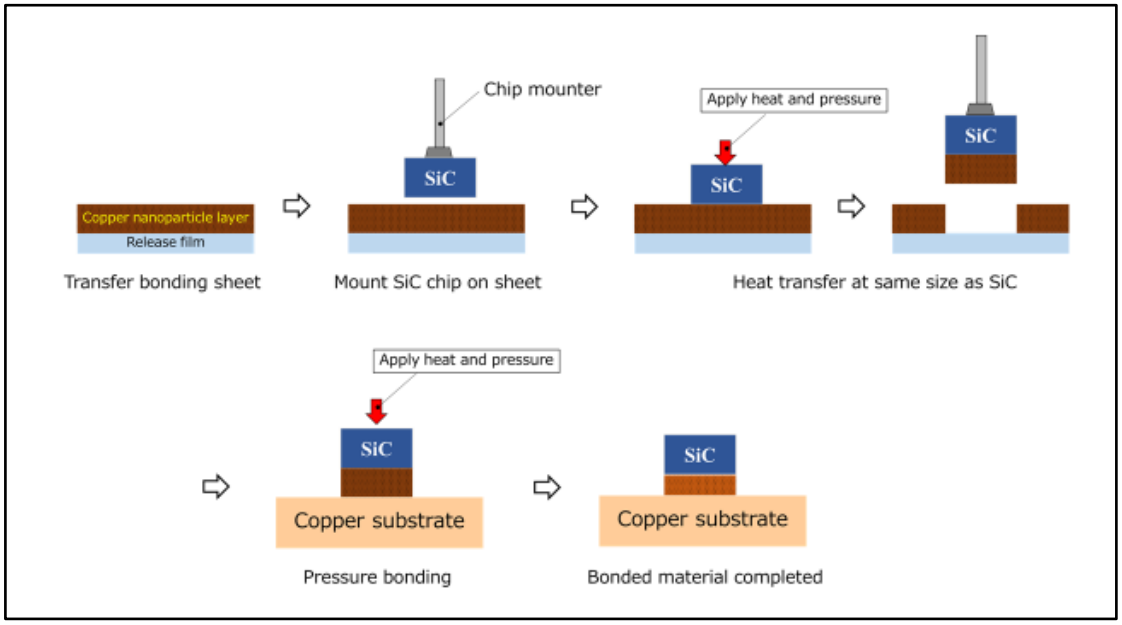

Diagram 1 Overview of transfer and bonding process of transfer bonding sheet

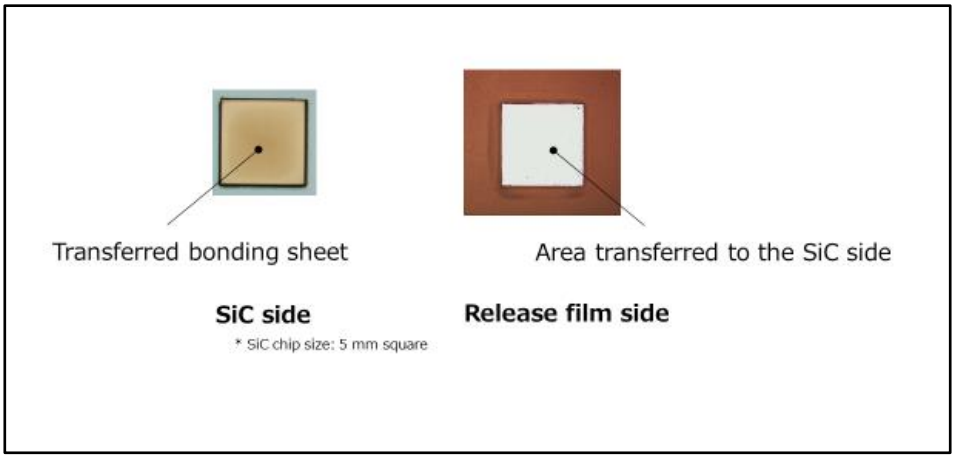

Diagram 2 Exterior view of SiC and release film after transfer of transfer bonding sheet

3. Future Plans

TNSC will conduct promotional activities targeting customers, along with conducting business development activities considering customer trends, with the aim of commercializing this bonding material.

TNSC will give a verbal briefing of its findings at the 29th Symposium on Micro binding and Assembly Technology in Electronics (Mate 2023) (Venue A, Program No. 21) to be held at Pacifico Yokohama on Wednesday, January 25, 2023.

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