Microball Bumping Technology of Nippon Steel Corporation

100% Ball Yield is Realized by Batch Bumping; the Technology Also Aims at Application in Three-Dimensional Packaging and MEMS.

●Freely alloyed solder balls are bumped in block

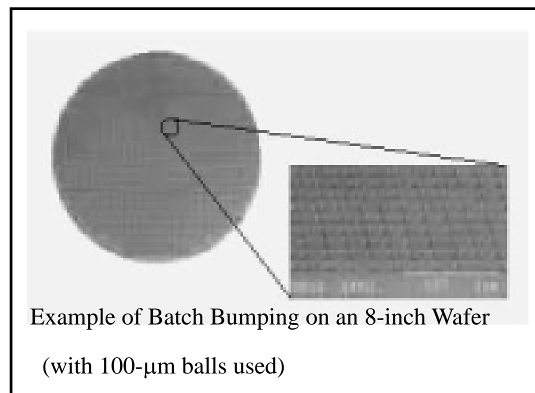
Nippon Steel Corporation's microball bumping technology was originally developed in the company's R&D efforts for gold bump formation. The technology was further improved by the application of the company's original wafer batch solder bump formation technology to meet the trend to switch from wire bonding to flip chip (FC) packaging and also to meet the semiconductor market's needs for higher performance, higher density, and higher operating frequency.

With wafer batch solder bump formation technology, high-accuracy microballs are used to secure high-accuracy and uniform bump height even when applied to large diameter wafers. As for the material, this technology can be applied to any material that can be used for microball production. In other words, various types of alloy compositions can be selected, including lead-free solder.

Nippon Steel Corporation and Nippon Micrometal Corporation have established high-accuracy microball manufacturing technology for metals of comparatively high melting points, such as types of Pb-Sn series solder alloy, Pb-free solder alloy, and gold alloy. The diameters of balls commonly used in industry today are on the order of 100 μm in the case of solder alloy balls for FC and 45 μm in the case of gold balls for TAB or FC, to an accuracy of ±2–3 μm, respectively.

Our solder bump formation process is roughly divided into four steps: (1) UBM formation by sputtering method or electroless Ni plating method, (2) application of flux by stamping method or printing method, (3) bumping of solder balls by use of adsorption and placement board, and (4) reflowing.

The most outstanding feature of our wafer batch bumping technology is found in the micro solder ball bumping process, which is a high-production technology to place balls of 250 μm or less and low tare almost flawlessly at high operation efficiency. If an error occurs, the automatic inspection and repair function is activated to achieve 100% yield prior to reflowing.



Example of Batch Bumping on an 8-inch Wafer (with 100-μm balls used)

●About 600,000 bumps can be formed at a 175-μm pitch

In April 2001, Nippon Steel Corporation started

the "Microball Bumping Pre-Production Sample Service." Through this service, we have proved that microball bumping technology can be a standard solder bumping technology, and we have developed or improved peripheral technologies required for full-scale mass production. Our technological achievements so far include formation of about 600,000 bumps at a 175-µm pitch on an 8-inch wafer and bumping on various UBMs. We have already cleared the hurdles with this technology for much narrower pitches; we are developing peripheral technologies and engineering mass production technologies at present.

For its excellent technological features, we are certain that our microball bumping technology will soon be the mainstream in connection with FC packages, which are increasingly used in general consumer products. Because of the versatility of the technology, which "simply places previously prepared microballs in to specified positions," we expect the technology will be applied to not only three-dimensional packaging in the semiconductor field, but also to MEMS engineering.

Nippon Steel Corporation is going to continue technological development for the innovation of packaging techniques on the basis of "Material Solutions," which makes use of the company's "material principles" acquired in past steel making operations as well as technological achievements accumulated through pre-production sample service and other operations.(*Takayuki Kaneko*, New Materials Division, Nippon Steel Corporation)

(For more information, contact us below.)

Technological Planning Group, New Materials Division, Nippon Steel Corporation
2-6-3 Otemachi, Chiyoda-ku, Tokyo 100-8071
Tel.: 03-3275-6944 Fax.: 03-3275-6790