SMIC's Solder Materials Support Next-Generation IC Packaging

Enjoying massive popularity, the market of tablet terminals and smartphones has been expanding at a phenomenal speed, and with the demand for even higher functionalities, advanced high-density packaging technologies have been required. In order to achieve better functionalities and higher densities, it is expected that chip-size packages (CSPs) become thinner and larger, and the appearance of new technologies and materials for three-dimensional (3D) packaging and wafer-level CSPs (WL-CSPs) are being sought. Senju Metal Industry Co., Ltd. (SMIC) has in its lineup solder materials that meet these requirements in accordance with different purposes and applications (Fig. 1). SMIC will propose many products at SEMICON Taiwan 2013.

Cu Core Balls Support 3D Packaging

A 3D package has a structure, wherein packages and electronic components are bonded in many stages, and substrates and components are repeatedly exposed to reflow temperatures in the vicinity of 250°C. As the result of 3D packaging, solder balls melt and collapse due to the application of load, and solder balls come in contact with one another, causing electrical short circuiting (Fig. 2). Responding to this issue, SMIC has been proposing copper (Cu) core balls, which easily secure space. As Cu, which constitutes the core of Cu core balls, has a melting point of about 1,080°C, the core of Cu retains its shape even after repeated thermal history by reflow, and hence Cu core balls secure certain space, making it easy for 3D packages to retain the 3D structure.

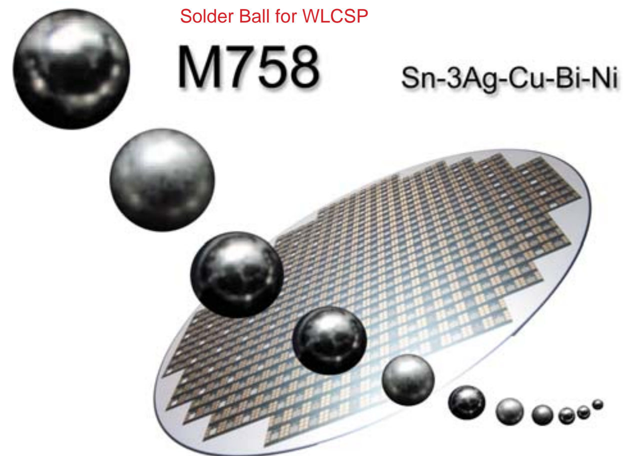

Fig. 2: Solder ball for WL-CSPs

Furthermore, even in packages with narrower pitches, Cu core balls can be achieved using existing equipment without the use of Cu pillars that require the plating process.

With the trend toward better functionalities and higher-density packaging, chips have been becoming thinner and larger. As a result, in the bonding between a substrate and a silicon (Si) with a small coefficient of thermal expansion, a defect can be assumed. This means the distortion due to the difference in coefficients of thermal expansion is applied on electrodes and solder balls, leading to collapse. SMIC has solved these challenges through the development of M758.

M758 is made by adding bismuth (Bi) and nickel (Ni) to Sn-3Ag-Cu to strengthen the solder structure through solid-solution strengthening and precipitation strengthening (Fig. 3). In addition, featuring strengthened bonding between the substrate and the Cu electrode of the chip as well, M758 proves to be an optimum solder ball for WL-CSPs, which provides excellent thermal fatigue resistance.

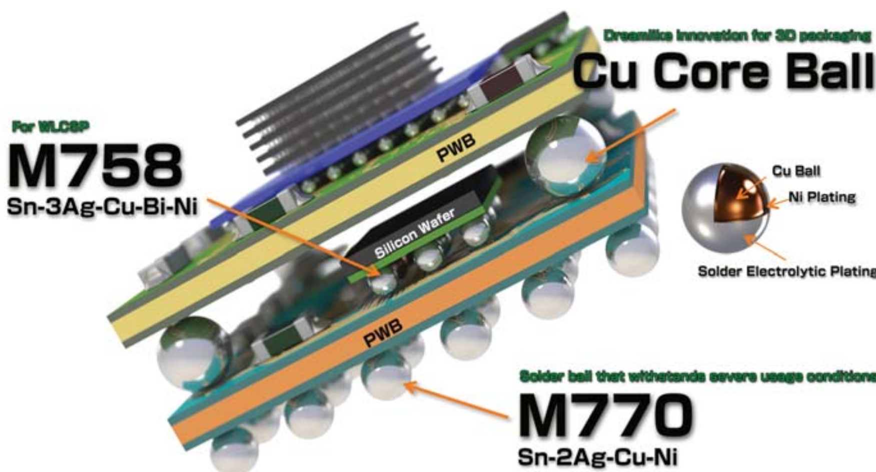

Fig. 1: Selection of best materials in accordance with applications

Both Thermal Fatigue Resistance, Drop Impact Resistance

Due to their nature, mobile devices are required to have drop impact resistance. In addition, the area of the battery incorporated in these devices has increased, leading to high-density packaging of the circuit section, and for this reason, measures for peripheral components to have thermal fatigue resistance are required.

SMIC has responded to these requirements by developing M770, a solder ball, which has both thermal fatigue resistance and drop impact resistance. In general, cracks relating to thermal fatigue property develop in solder bulks, while cracks relating to drop impact property develop at bonded interfaces. The pursuit of better thermal fatigue property tends to lead

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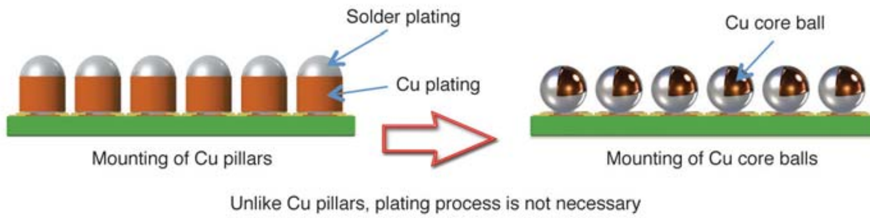
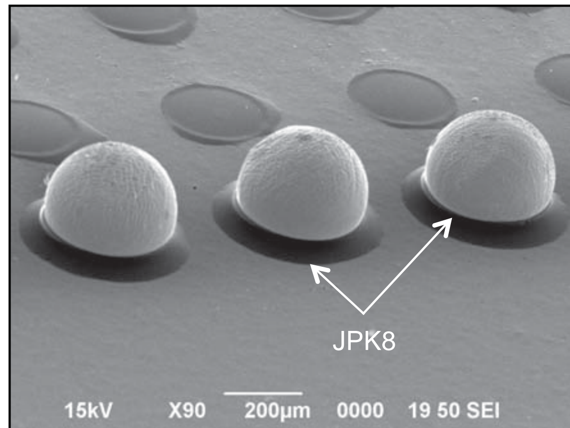


Fig. 3: Narrow-pitch packaging without the risk of short circuiting is possible using existing equipment



Flux residue improves bonding strength by about 50 percent

Fig. 4: In JPX8, flux residue becomes epoxy resin

to poor drop impact resistance, and the pursuit of drop impact resistance tends to lead to poor thermal fatigue resistance. Measures for achieving both thermal fatigue resistance and drop impact resistance have been difficult as approaches to achieving respective properties contradict with each other. To overcome this challenge, SMIC has adjusted the amount of silver (Ag) so that the solder has flexibility and at the same time exhibits excellent thermal fatigue resistance. The achievement of drop impact resistance is attributable to the addition of Cu and Ni. Cu and Ni that are commonly used for the surface treatment of packages and Sn, which is the main component of lead-free solders, react easily, and form a thick alloy layer. However, the addition of Cu and Ni suppresses the reaction at the bonded interface, enabling the creation of a very thin alloy layer. M770 is a solder ball, which provides a buffer against the development of cracks that develop at the bonded interface between the solder and substrate due to drop impacts. It also provides a buffer against the development of cracks that develop in the solder bulk during the heat cycle test.

Proposal of Fluxes According to Applications

With the trend toward better functionalities, packages have become smaller and come to have smaller footprints. As a result, narrower pitches and non-cleaning are required for the mounting of solder balls and hence the selection of fluxes has become important. SMIC proposes fluxes in accordance with applications, including WF-6317 and MB-T100 with excellent wettability, low volatility and cleaning performance; the DELTALUX 901K Series, a low-residue flux, which allows the injection of underfill without the need for cleaning after mounting; and Joint Protect Flux JPK8 (Fig. 4), which exhibits good adhesion with underfill materials as flux residues play a role of strengthening the joint.

About This Article:

Senju Metal Industry Co., Ltd. provided the contents of the article

Government Perks Boost Electronics Investment in India

Following the implementation of the Modified Special Incentive Package Scheme (MSIPS) of the Department of Electronics and Information Technology of the Government of India, a slew of investors have already signified their intention to avail of the perks related to the program. More recently, Rs 961 crores or US$158.8 million worth of investments proposals from major technology companies have been approved in the electronics design system and manufacturing (ESDM) sector in India.

Of this, Rs 406 crore or US$67.1 million has been approved for Samsung India Electronics Pvt. Ltd. for the manufacture of smartphones at Noida, which is expected to be implemented within the next six months. Rs 544 crores or US$89.9 million of investments was approved for Bosch Automotive Electronics India Ltd. for the manufacture of automotive electronics devices, like electronic control unit (ECU) engine system, ECU brake system, and body computer module in Bangalore. Meanwhile, Rs 11.1 crores or US$1.8 million of investment from Indian firm Sahasra Electronics has also been approved for the manufacture of light-emitting diode (LED) lightings and will be implemented over five years.

To date, a total of more than Rs 4600 crores (US$760 million) of investment applications have been received by the government under the MSIPS. The consumer electronics and appliance sector received the largest amount of investment applications (Table).

During the turnover of investment approvals, Shri Kapil Sibal, Minister for Communications & IT and Law and Justice, said, "It is important to boost manufacturing, and the Government is trying to promote manufacturing to create employment and bring in latest technologies in the country to serve the domestic market as well as exports. Finalization of MSIPS application in such as short span of time will help create the right atmosphere for more investment attraction in the ESDM sector in India." ❑

Table: Status of MSIPS application

Sector	Amount (Rs crores)	Approved
Consumer electronics and appliances	450	Nil
Handheld devices	6744	406
Telecom products	1770	Nil
LEDs and LED products	310	11
Electronic components	45	Nil
Automotive electronics	610	544
Power electronics	40	Nil
Strategic electronics	210	Nil
ATMP – Semiconductor	750	Nil

*as of July 29, 2013
*Total investment involved is about Rs 10929 crores

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