Technology Focus

SMIC Customizes Solders to Meet Market Evolution

Nearly 10 years have passed since the start of full-scale adoption of lead-free solder. The days of using M705 (Sn-3Ag-0.5Cu) as standard solder material for various applications are over. Today, individual companies are selecting their own solder materials in accordance with their purposes and applications. This trend indicates that lead-free material technologies and evaluation technologies of individual customers have reached a maturing period.

Senju Metal Industry Co., Ltd. (SMIC) offers materials that are appropriate for a purpose and application to meet the requirements of the present day (Fig. 1).

No Conflict Minerals Used

The major concern regarding solder material right now is the obligation to disclose information on whether or not the materials contain conflict minerals (Photo 1). The electronics manufacturing industry is obliged to report conflict mineral contents to the U.S. Securities and Exchange Commission (SEC) and to clearly indicate this information on their websites.

Photo 1: Solder balls containing conflict materials are required to be disclosed.

The Electronic Industry Citizenship Coalition (EICC) does not tolerate extraction and transportation of minerals that can become a source of funding for conflicts. EICC has started investigating the amount of conflict minerals used in supply chains, as well as the measures that the industrial community can implement to eliminate the use of conflict minerals. As this investigation is extremely complex, there are many questions as to whether or not the investigation process is appropriate.

SMIC audits smelters to ensure that none of raw materials used by SMIC for its products have originated in conflict regions, and clearly indicates the method the company uses for handling this matter on its website.

Low-Ag, Halogen-Free Solder Paste

Customer demands for low-priced solder paste are increasing rapidly due to a significant rise in the cost of metals, such as silver and tin, used as raw materials for solder. To respond to these demands, SMIC has developed ECOSOLDER PASTE M40 (Photo 2). It is an epoch-making solder paste that enables mounting of components using the same profile as that of the conventional M705 (Sn-3Sg-0.5Cu) and offers a performance equivalent or higher than M705. To respond to customer requests for lower prices, SMIC has also developed ECOSOLDER PASTE M46. Although M46 contains 0.3 percent silver (Ag), it has been developed with emphasis on achieving a low melting point so that mounting conditions equivalent to M705 can be provided. As a result, SMIC has been able to reduce the cost significantly in spite of having the similar mounting conditions.

Low Dross, No Silver

When the flow soldering method is used, the amount of solder waste in the form of dross is larger than the amount of solder used for a product.

SMIC has developed an inexpensive flow solder called ECOSOLDER BAR M24MT that does not contain silver and reduces the generation of this dross.

In the conventional flow soldering

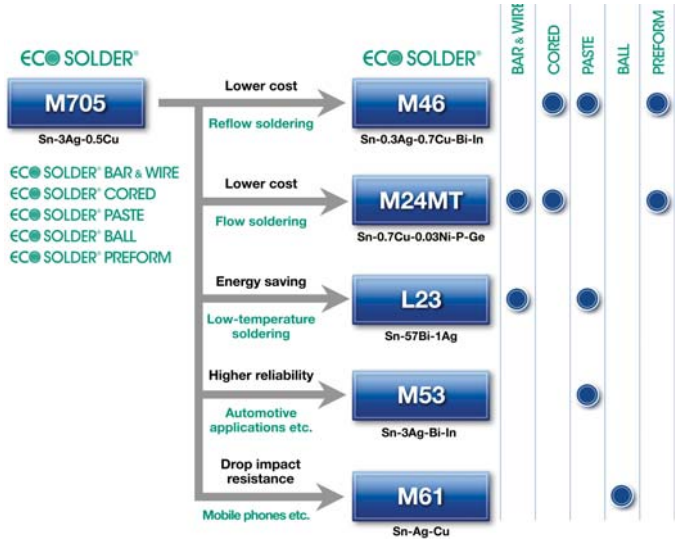

Fig. 1: SMIC has a broad range of solder-related materials for various industry needs.

Photo 2: ECOSOLDER PASTE M40 and 46

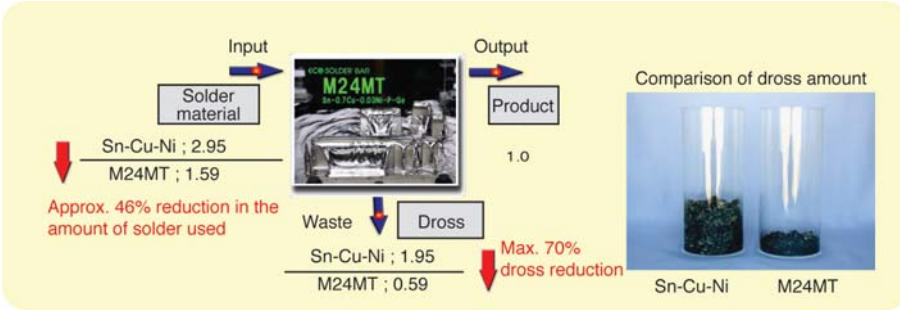

Fig. 2: Dross amount in flow soldering method is larger than the solder used.

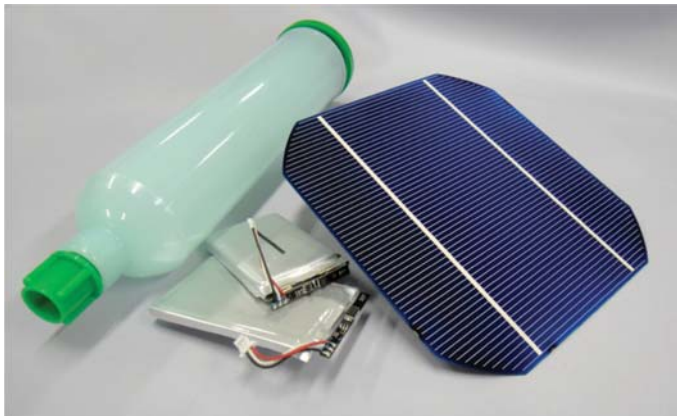

Photo 3: ECOSOLDER PASTE L20 and L23

method, "2.95" solder is required to produce a "1" product. When M24MT is used, "1.59" M24MT is sufficient to produce a "1" product, which translates into approximately 46 percent reduction of the amount of solder used in real terms. Therefore, SMIC has made it possible to lower the cost with M24MT. Fig. 2 shows how dross of "1.95" generated with the conventional soldering method has been reduced to "0.59" when M24MT is used. As M24MT does not contain any silver, about 50 percent of the cost of ingot alone can be reduced in comparison with M705 (Sn-3Sg-0.5Cu).

When the reduction of dross is added, a considerable cost cut can be achieved using M24MT.

Low Melting-Point Material

A solder paste that allows reflow at low temperature with a short soldering time is required for soldering solar panels and mounting method for the purpose of saving energy.

SMIC has developed the Sn-Bi-based ECOSOLDER PASTE L20 and L23 (Photo 3) to enable component mounting at low temperature with a short soldering time. The reason why manufacturers have avoided using the Sn-Bi-based solders is because they form the low-melting-point chemical compound Sn-Bi-Pb with lead (Pb) and deteriorate reliability. Of late, however, the use of Pb has been abolished from the plating of components' terminals and thus the practical application of Sn-Bi-based solders has become possible.

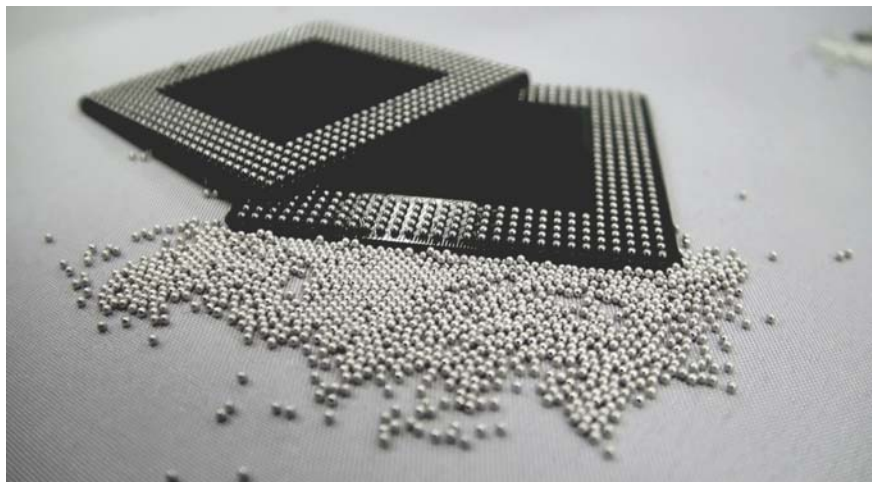

Photo 4: ECOSOLDER BALL M61

When L23 is used, components can be mounted at 180°C, which means it can achieve an energy saving of approximately 30 percent compared with M705 (Sn-3Ag-0.5Cu).

High-Reliability Bump Connection

The recent rapid increase in mobile devices such as digital cameras and smartphones has led to a growing demand for solder balls that have a high drop impact resistance to reduce the risk of damage to a device if it is dropped.

SMIC has developed the ECOSOLDER BALL M61(Photo 4), which has excellent drop impact resistance. When the conventional solder ball is used, a drop impact can damage the location of the thick diffusion layer that is formed on the surface of joint boundaries with a substrate. When M61 is used, this diffusion layer can be made thinner, which significantly improves the resistance to drop impact and achieves high-reliability bump connection.

Solder balls with high thermal shock resistance are also in demand. SMIC has developed the ECOSOLDER BALL M60 to meet this demand. The thermal shock resistance of conventional solder balls deteriorates because of damage to the Ag_3Sn layer networking structure that maintains the strength of the alloy. To avoid this problem, M60 uses a chemical composition that prevents damage to the networking structure even after a thermal shock test. As a result, M60 provides excellent thermal shock resistance.

Trend of 20µm-Size Solder Balls

As lighter, lower-profile, shorter, smaller, and lower-priced packages with three-dimensional (3D) construction are developed, numerous micro-solder balls have to be deposited on large wafers using the micro-ball feeding method. Therefore, ultra-fine solder balls that have high accuracy, high sphericity, and narrow tolerance are required for forming bumps.

SMIC has applied advanced classification technology and its original membrane emulsification technique using the sand of Shirasu-Daichi (a broad pyroclastic plateau in southern Japan) to develop a high-reliability solder ball that can comply with the above requirements. At present, the mainstream micro-ball size is Ø50µm (Fig. 3). Because there is

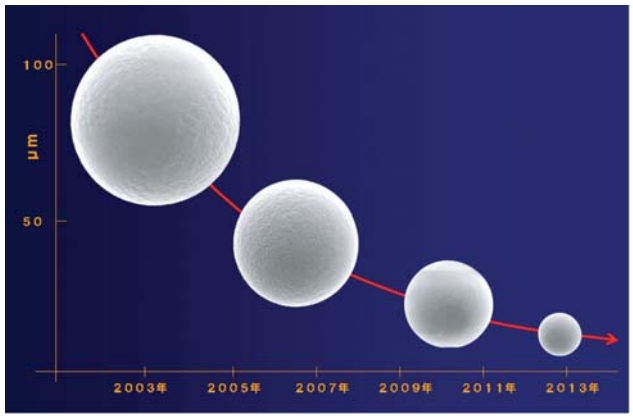

Fig. 3: Trend of 20μm-size solder balls

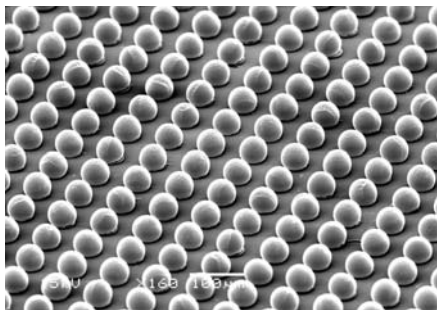

Fig. 4: Five million solder balls deposited on a 12-inch wafer

a continuing demand for even narrower pitch, SMIC is targeting commercial application of Ø20μm micro-balls by applying these technologies (Fig. 4).

Achieves Ø30μm Pitch Mounting

SMIC considered it difficult to achieve a narrower pitch of 30μm or less using technologies that are a direct extension of existing technologies. Therefore, the company developed the "Precoat by Powder Sheets (PPS)" process (Fig. 5) based on a completely new concept and as a result, was able to deposit solder balls with a 25μm pitch. PPS is a transfer solder sheet, which is a film coated with an adhesive agent on which a layer of ultra-fine spherical solder powders with narrow grain distribution (manufactured using a membrane emulsification technique) are deposited at high density.

In the PPS process, the soldering surface of the transfer solder sheet is brought into contact with the surface of a circuit board, and press heat is applied to transfer the solder on the patterns only. Then, the solder is formed on the required portions by peeling off the sheet. For bumps, reflow heating is performed after applying flux and then solder powder is melted to form micro-bumps.

Facilitates 3D Mounting

Of late, 3D mounting has become the mainstream method for mounting ultra-small module components on a circuit board. This method, however, has a low yield under the present conditions in terms of mass production.

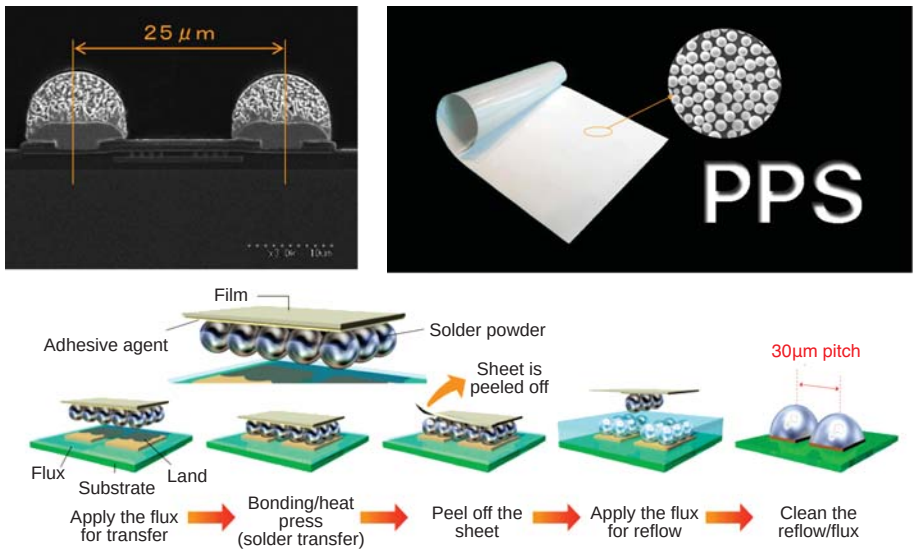

Fig. 5: PPS process

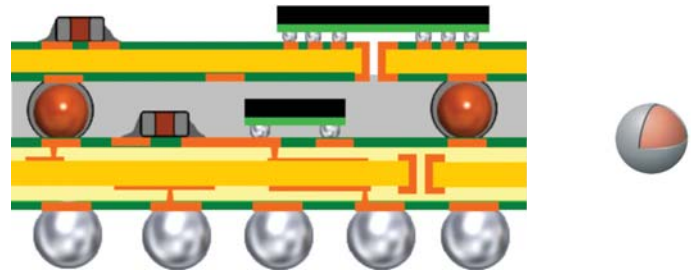

Fig. 6: Copper core solder balls

Photo 5: ECOSOLDER CORED CBF

To make 3D mounting easier, SMIC has developed a copper core solder ball (Fig. 6) with a narrow tolerance that is a spherical copper solder ball coated with solder material. The solder material on the surface of copper core solder balls is used to make connections between substrates. The copper solder ball also serves as a spacer because of characteristics that prevents it from melting at the mounting temperature. Therefore, the copper core solder ball can be used to assure a fixed space between substrates and achieve 3D mounting with a high mass-production capacity.

Assures Superior Wettability

Today, halogen-free is a standard specification for all solder products including flux cored solder. Halogens such as chlorine and bromine have the capacity for excellent solder wettability, which makes them indispensable substances for soldering. Because of this, halogen-free flux cored solders have a problem regarding wettability. SMIC has developed the ECOSOLDER CORED CBF (Photo 5), whose chlorine and bromine contents have been reduced to 900ppm or less, making it compliant with the standard specifications. The newly developed ECOSOLDER CORED CBF is a high-quality halogen-free flux cored solder that does not produce any bridge because it assures superior solder wettability and separation even for single-stroke soldering, which tends to produce bridges, is applied. ❑