Latest Soldering Solutions Enhance Bonding Process

SMIC OFFERS ADDITIONAL VALUES FOR BONDING BY ADOPTING ONE-STEP-AHEAD SOLDERING TECHNOLOGY AND STATE-OF-THE-ART BONDING MATERIALS, THUS ENABLING APPROPRIATE RESPONSE TO A VARIETY OF SOLDERING DEMANDS.

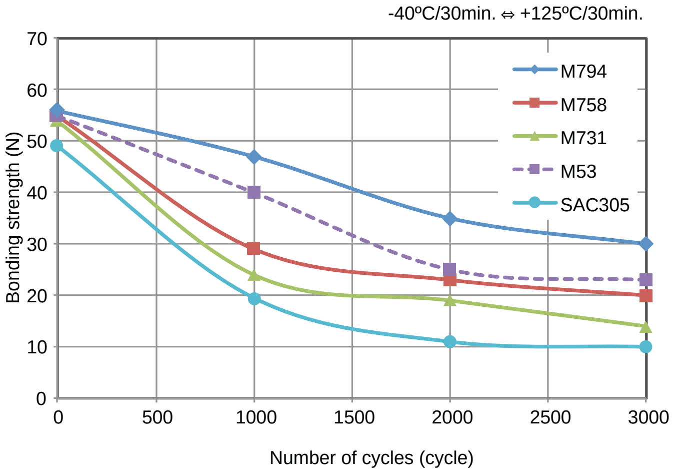

Fig. 2: Comparison of bonding strength of each alloy

Lead-free soldering has become increasingly diverse and additional demands for materials and manufacturing methods, which are optimal for specific applications, have been noted. Senju Metal Industry Co., Ltd. (SMIC) has been providing soldering support through total solutions that aim at creating one-step-ahead soldering technology using the company's proprietary soldering technology. For example, SMIC develops high-reliability bonding materials with advanced material development capacity and proposes a unique compounding technology, in order to create new values for bonding process.

High-Thermal-Fatigue-Resistant Alloy

The availability of lead-free solders has advanced the use of high-reliability tin- (Sn), silver- (Ag), and copper-based (Cu-based) solders for electric and electronic devices and electronic components. In recent years, there has been an increasing demand for the use of lead-free solder for equipment under severe operating conditions such as automotive applications.

Copper-tin and silver-tin intermetallic compounds are included in the Sn grain boundary of Sn-Ag-Cu-based solder to form a network structure and produce a pinning effect so that deformation is suppressed and a high bonding quality is maintained through precipitation strength. When more stringent conditions for specifications are required, it is difficult to guarantee the bonding quality simply by precipitation hardening.

The first steps in improving the bonding quality are achieved by a combination of precipitation hardening and solid solution hardening. Solid solution hardening is a bonding strength improvement method that suppresses transition and deformation. This method warps the lattice by including different types of atoms (such as bismuth (Bi)) in tin. Representative solder products such as M53 (Sn-Ag-Cu-Sb) and M731 (Sn-Ag-Bi-In) are available from SMIC.

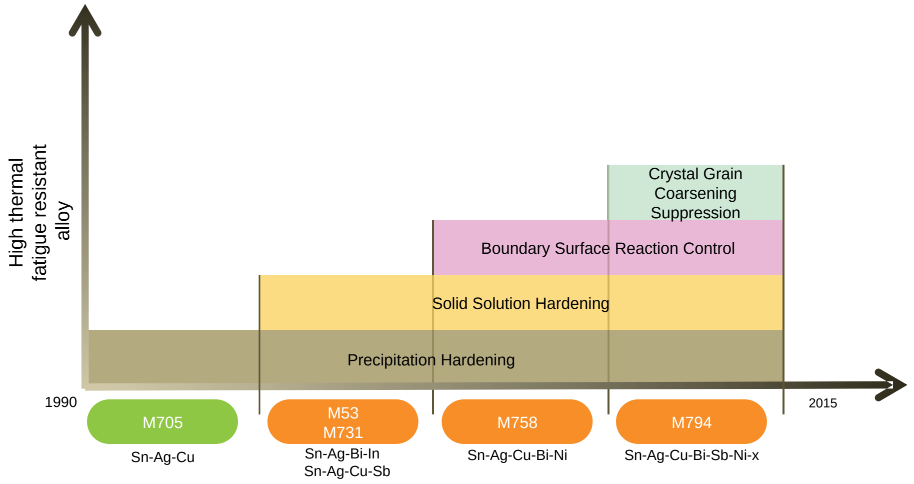

Fig. 1: Development of high-thermal-fatigue-resistant alloy using new technology

The second bonding strength improvement method is achieved by controlling the reaction to prevent changes in the fracture mode. This method forms a thinner diffusion layer (portion susceptible to solder joint failure that is easily fractured) of the bonding interface by adding nickel (Ni) to form a finer and more flat layer. Representative solder products such as M758 (Sn-Ag-Cu-Bi-Ni) are available from SMIC.

Finally, the third bonding strength improvement method is achieved by including different types of alloy atoms in grain

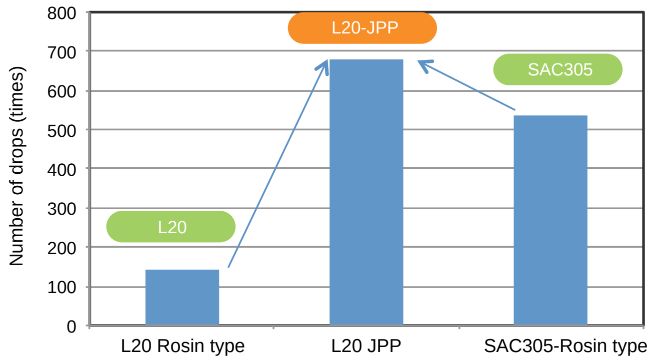

Fig. 3: Approx. five times higher falling shock resistance

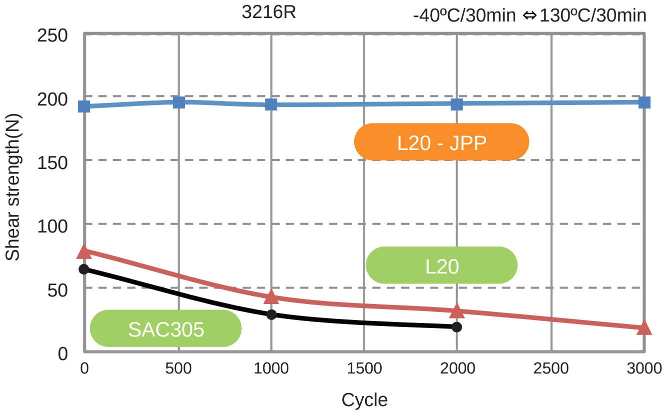

Fig. 4: L20-JPP has thermal fatigue resistance higher than SAC305

boundary in order to suppress coarsening of the tin structure, drop in bonding strength, and occurrence of cracks. Representative solder products such as M794 (Sn-Ag-Cu-Bi-Sb-Ni-x) are available from SMIC. SMIC offers these materials so that users can select the optimal material in accordance with the application to achieve lead-free soldering for products used even in the harshest operating environment.

Strengthening Bonding with Flux Residue

When the component size is smaller (such as a 0201-sized chip), a smaller amount of solder is applied thus the soldering will exhibit low bonding strength. On the other hand, it has become difficult to mount low-thermal-resistant components, and the energy consumption of soldering has increased because lead-free solder requires the use of higher temperatures for mounting the components.

To resolve these problems, it is ideal to use low-melting solder materials for mounting components at low temperatures, for which Sn-Bi-based materials are recommended. Sn-Bi-based materials, however, are rigid and fragile and also have low drop shock resistance. Therefore, these materials are not used widely. SMIC has resolved these two problems by developing L20-JPP. An epoxy-based curing resin is mixed in the Sn-Bi-based solder paste of L20-JPP.

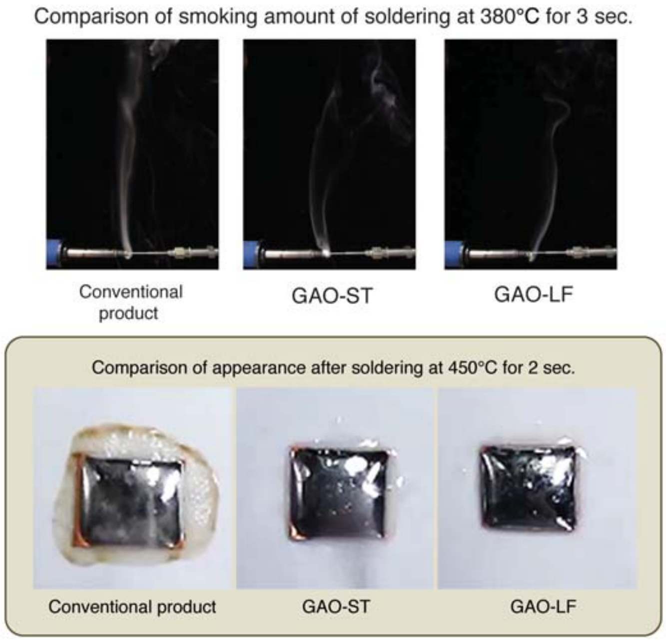

Fig. 5: Aiming at an excellent working environment and clean soldering appearance

L20-JPP has more than two times higher bonding strength than SAC305 (M705) and five times higher drop shock resistance than L20 rosin-based flux because L20-JPP eases the stress put on the solder joint portion. L20-JPP suppresses reactivity to each type of material included in the paste and provides excellent long-term stability and continuous printability. For these reasons, prospects for L20-JPP as a new material become high.

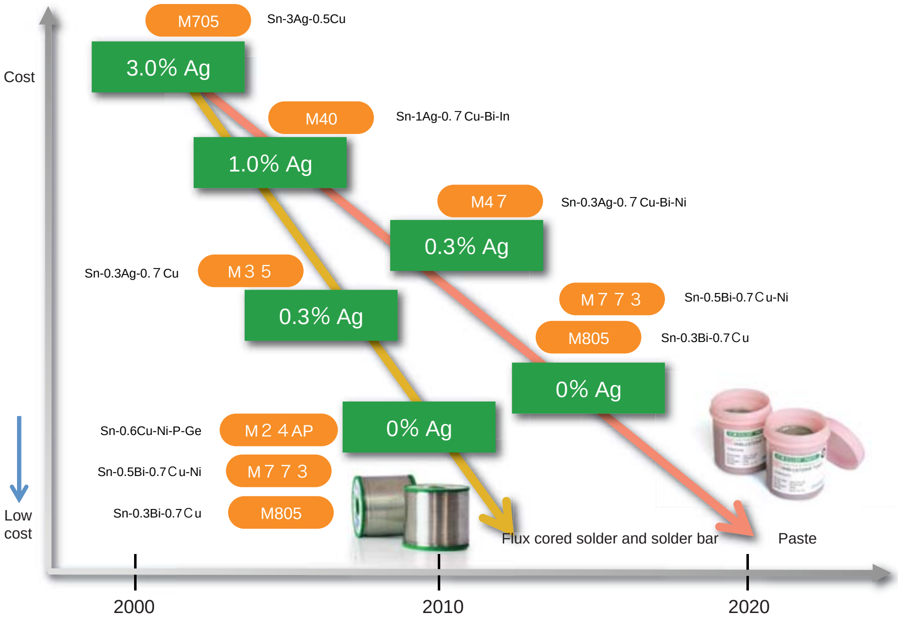

Fig. 6: Use of low-silver and free-silver solders to reduce cost

Solder at Low-Melting Point Solder

There were high expectations for Sn-Bi-based solders as a prime candidate solder for low-temperature mounting. There was, however, no flux cored solder that enables solder retouching. For that reason, widespread penetration of Sn-Bi-based solders did not take place. To realize low-temperature soldering, SMIC developed a Sn-Bi-based solder (that has rigid and fragile characteristics) by fully utilizing the company's proprietary wire drawing technology and manufacturing technology and introduced it to the market as a flux cored solder.

Flux Cored Solder for Working Environment

In recent years, a soldering method that performs soldering in a shorter time by using a higher-temperature soldering iron tip is used increasingly. The problem, however, is that the working environment degrades when soldering is performed at high temperatures, for example, scorching of flux on components or increase in fume with a pungent smell.

To resolve this problem, SMIC has developed GAO-ST and GAO-LF by applying the company's long expertise in flux development. GAO-ST completely suppresses scorching and air bubbles, whereas GAO-LF further suppresses fume and the pungent smell.

Lower Cost with Low Ag, No Ag

There has been strong demand for making lower-cost solder by reducing the amount of Ag in the solder. When the amount of Ag content in the solder is reduced, it increases the melting point temperature of solder, and lowers the bonding strength and wettability.

To resolve this problem, SMIC applied a solid solution hardening method by adding very small amounts of bismuth (Bi) or indium (In) in order to improve the portions where precipitation strengthening dropped because of using less amounts of silver. Furthermore, SMIC has successfully developed a solder that can maintain high bonding quality even with no silver by using a bonding interface control technology.

SMIC offers low-Ag and Ag-free solutions with the following product lineup: M40 enables soldering using the same profile as M705; M47 provides excellent drop shock resistance by using a boundary surface reaction control technology; M773 achieves low cost by solid solution strengthening and using the bonding interface reactivity control technology; M805 improves wettability by adding extremely small amount of bismuth.

In addition, the M24AP and M24MT flux cored solder and a solder bar that completely suppress dross are available.

Solder Material for Bonding on Aluminum

In recent years, lightweight and low-cost aluminum is widely used for electric wires and coils in place of copper. When conventional Sn-Ag-Cu-based lead-free solder is used, there is a problem of bonding defects because of galvanic corrosion that is caused by the standard potential difference between tin (Sn) and aluminum (Al).

SMIC has resolved this bonding defect problem caused by galvanic corrosion by developing tin-zinc-based (Sn-Zn-based) solders called ALS A151 and ALS091. These products are provided with an aluminum-zinc bonding boundary to reduce the standard potential difference. On the assumption of bonding thin-wire coils, ALS A151 and ALS091 prevent aluminum erosion by adding aluminum, which considerably expands their range of application.

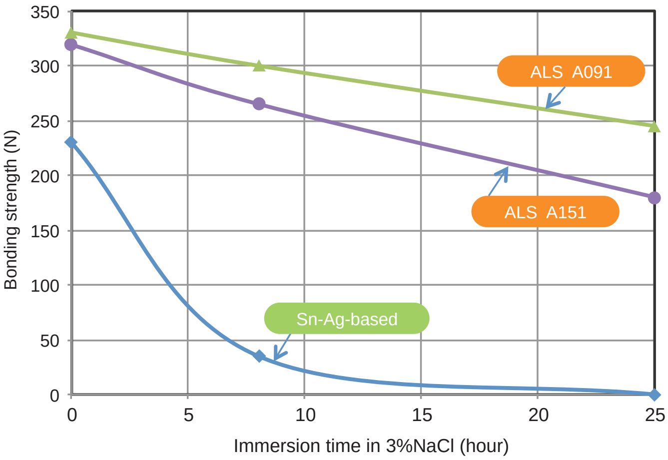

Fig. 7: Comparison of bonding strength degradation caused by corrosion

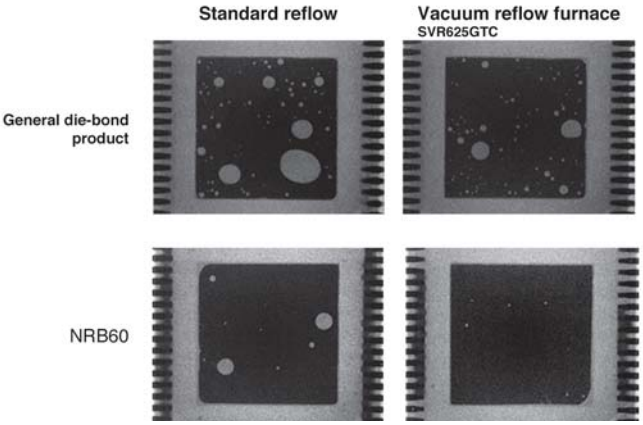

Fig. 8: NRB and SVR-625 GTC are solutions for solder scattering and voids

Void-Free and Flux Residue-Free Soldering

SMIC contributes significantly to semiconductor chip soldering by developing residue-free solder paste for making non-rosin-based flux. SMIC offers an abundant product lineup, including residue-free NRB40, which is ideal for large area die bonding; NRB70, which is flux residue free even when using an air reflow furnace; and NRB60, which achieves less scattering and is free from residue and voids when using SMIC's SVR-625GTC reflow furnace (developed only by SMIC with its comprehensive know-how on soldering).

About This Article:

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