SMIC Connects Future through Solder Technology

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As a pioneer in solder development, SMIC has acquired enormous technical knowledge, and is fully equipped to respond to various issues that arose along the way. Leveraging on this expertise, the company stands ready to meet all future solder requirements amid the continuous evolution of the semiconductor, automotive, and electronics sectors.

Since its founding in 1938, SENJU METAL INDUSTRY CO., LTD. (SMIC) has supplied solder materials and soldering equipment that are indispensable for various industries, including electronics and automotive industries. Product development that contributes to the achievement of technologies and innovations that meet the needs of the advanced fields of the time has given birth to state-of-the-art solders. In a recent interview with AEI, Yuji Kawamata, Ph.D., Executive Director, General Manager, Development & Engineering Div., SENJU METAL INDUSTRY CO., LTD., described the history of solders and soldering technologies of the coming generation.

AEI: *Could you share with us the history of solders?*

Kawamata: Solders have been used for 5,000 years or longer. The first eutectic solders, comprised of tin (Sn) and lead (Pb), were discovered for their convenience of a single melting point. These alloyswere used regularly until the 1990s, when health concerns and protection of the global environment became a major motion. The demand to fully abolish the use of lead in the realm of solders was also targeted. As a natural move for a leading solder company, SMIC led the world in the developmentof a benchmark lead-free solder and brought it into the market.

AEI: *Following this trend, SMIC announced in 1996 a lead-free solder, ECO SOLDER M705. What happened during its commercialization?*

Kawamata: We developed a highly reliable tin-copper-silver (Sn-Cu-Ag)-based lead-free solder and obtained a patent. We also made this patent available to other manufacturers, helping to promote the use of lead-free solder in consumer electronics and other electronic products. As a result of this and the technical capability of these alloys, the use of lead-free solders quickly spread as a common global standard. Although lead-free solders had challenges such as higher material costs and increased melting temperatures compared with conventional Sn-Pb eutectic solders, SMIC overcame these challenges by leveraging its solder developing capabilities and technological know-how. We also commercialized a lower-silver lead-free solder containing a minimum amount of silver possible without sacrificing joint reliability and solderability. Furthermore, we developed a tin-bismuth (Sn-Bi)-based lead-free solder for low-temperature applications, in which the flux residue reinforces the final joint. It has received high acclaim from various industries. Of course, industry development never slows and lead-free solders will continue to evolve.

AEI: *In FY2014, SMIC received its 11th Supplier Continuous Quality Improvement (SCQI) Award from Intel Corporation, an award you have achieved for six straight years. How has your technology helped the semiconductor industry?*

Kawamata: Interestingly, some materials now used primarily within semiconductor field we developed earlier for other uses. For example, we began manufacturing a silver core solder ball in 1977, a material which raised the curtain on the age of a now common semiconductor package. In the 1990s, ball grid arrays (BGA) packages employing solder ball technology inherited from the earlier technology were then used as external electrodes at the bottom of components. Ball use in place of lead frames significantly contributed to high-density mounting. We have met the advancement of the semiconductor industry by providing customers with solder materials and equipment that employ cutting-edge interconnect technologies, including original solder pastes, solder balls, semiconductor fluxes, semiconductor mounting equipment, and Injection Molded Solder (IMS) equipment. Our development of materi-

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als and process technologies with every player in the semiconductor industry has fueled growth in the market, but we are of course proud of our award achievements.

AEI: *SMIC plays a significant role in the production of ultraminiature components, an emerging technology for electronic components manufacturers. Could you describe your company's effort in this area?*

Kawamata: SMIC has been conducting research and development from all angles of diverse technologies. The finer the powder becomes in solder pastes for surface mount technology (SMT), the larger the surface area becomes and the more easily these particles may oxidize. Therefore, we have developed a high-performance flux, which inhibits the naturally occurring viscosity increase phenomenon, and have developed a paste suppressing reoxidation in the reflow process in order to accommodate 0201-size ultraminiature components.

AEI: *The advancement of solders is indispensable for next-generation power semiconductors, the adoption of which has begun in automobiles, industrial equipment and social infrastructure as well. How do you accommodate them?*

Kawamata: Current power semiconductors have been shifting use from silicon (Si) to next-generation products that may use silicon carbide (SiC) and gallium nitride (GaN). In particular, SiC power devices attract attention as semiconductors featuring high efficiencies and resistance to high voltage requirements. However, SiC power semiconductors that operates at high temperatures present a severe usage environment for solder materials. At present, SMIC has been developing a solder technology that withstands a heat of 250°C in conjunction with Ibaraki University. We are aiming at the development of a material made of "super-ultra" solder plastic targeting a melting point of 450°C or higher by 2016.

AEI: *How do you deal with Sn whiskers, a potential issue of lead-free solders, during the development process?*

Kawamata: Amid the shift to mounting using lead-free solders, the components' terminal plating has also shifted to pure tin in various forms. However, in general, whiskers tend to develop by the tin plating process. It is considered that whiskers form through the recrystallization of plated metal due to residual stress from the plating. Previously, ductile lead was preventing the development of the internal residual stress. With the shift to lead-free solders, it has been a concern that whiskers might lead to short-circuiting between printed wiring board patterns, upon which ultraminiature electronic components are densely mounted. SMIC took measures against the generation of whiskers from the standpoint of solder materials and has created an alloy to mitigate or prevent whiskers, in which an additive alleviating residual stress is added, thus helping to reduce concern about the potential for short-circuiting due to whiskers.

AEI: *Your company supports those soldering by providing materials, equipment and process know-how as a total solution. How do you cater to various requests from customers?*

Kawamata: We compile all incoming customer requirements for solder materials in an internal "development and improvement request" database. Sales and technical support personnel from the Solder Technical Center accompany customers with personal visits to their facilities. Every month, we meet hundreds of requests from customers by categorizing them into prototyping support, evaluation analysis, installation test and other requests. We listen to what customers have to say and immediately make appropriate proposals, thereby solving problems quickly. We also make plans for joint development activities. Through the accumulation of technological development, we now possess in our lineup more than 2,000 commercial varieties of products, with a practically unlimited number of products feasible. By squarely challenging customers' requirements, we continue to come out with evolutionary and disruptive new products for our industry. This forms our base for the future of technological development. ❑

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