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AEI

ASIA ELECTRONICS INDUSTRY

TECHNOLOGY FOCUS:

Board Bending Gets Boost

Timing Device Shapes up

SPECIAL REPORT:

Components Hinge on New Phone Features

ZOOM IN:

3D V-NAND Solves Chip Design Limits

Anodes Comply with Global Standard

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See you at HKPCA & IPC 2013

The wafer-level-packaging market shows the greatest potential for significant growth in the future. Particularly, the middle-end infrastructure sector is growing, which is a strategic area where foundries, outsourced semiconductor assembly and test (OSATs), and integrated design manufacturers (IDMs) have stepped in.

Senju Metal Industry Co., Ltd. (SMIC) compares OSATs, which represent virtual IDMs, and Chip-on-Wafer-on-Substrate (CoWoS) by Taiwan Semiconductor Manufacturing Co., Ltd. for the vertical integration approach. The strength of CoWoS is that it supplies a turnkey solution for customers, and it is appealing to the market. OSATs cannot provide the same service as TSMC's CoWoS, but they have worked on 2.5D structures, such as package on package (PoP) and fan out wafer level packaging for a long time, according to SMIC. The abundant experience and technology of OSATs will still allow them to survive in the market. As the semiconductor industry is progressing integration, like silicon in package or silicon on chip for next-generation market, such as Internet of Things (IoTs), big data, and wearing technology, among others and needs more chips to build interface devices, shrink the scale, and shorten the electronic delivery path.

SMIC says 3D structure still has its limitation. In the past, more density on smaller packages is being pursued, but the recent consumer trend has changed a little bit. New products like smartphones are becoming larger and larger. This does not make 3D packaging that necessary and urgent in the field. Furthermore, 3D packaging still has many process challenges for engineers to overcome. Thus, the balance shall be maintained in the short term.

Senju Metal Industry is the leading company in the solder industry. The company places emphasis on its R&D resources, and R&D investment enables the company to provide products from solder bar, paste, flux, ball and even new technologies to deal with different needs from customers, and will be able to provide appropriate products as long as customers still use solder for jointing.

Members of SMIC Headquarters and SMIC Taiwan Branch grace the cover of AEI December. From left: Jason Yeh, Flux Team Supervisor, SMIC Taiwan Branch; Lewis Huang, Deputy General Manager, SMIC Taiwan Branch; Okuno Tetsuya, General Manager, SMIC Headquarters TC Division; Okuno Masaharu, General Manager, SMIC Taiwan Branch; Clement Chang, Ball Team, SMIC Taiwan Branch, Water Tsai Paste Team Supervisor, SMIC Taiwan Branch; and Bella and Hsuning, SMIC Taiwan Branch Assistants.

As OEMs dominating the mobile industry and China-based OEMs work directly with silicon and package foundries, material adoption is expected to evolve. SMIC thinks this will open new opportunities for the company, which will be influenced by end users. As technology keeps polishing, end users begin to ask for a total solution, from wafer manufacturing to EMS, from products to technical support. SMIC is able to provide various products and R&D support. The new integration trend allows it to give suggestions to customers actively, so there will be more chances for business in the future.

SMIC is also striving to find the next trend of material. However, both 2.5D and 3D structures face challenges for maintaining packaging space and coplanarity. Heat dissipation and other new challenges also arise from the new structures. Therefore, the company makes micro solder balls (under 100μm) for fine pitch challenges. For solder ball alloys, SMIC proposed M770 alloy, which is good for both TCT and drop performances for substrate base package and M758 alloy for wafer level package especially enhance its TCT performance. Copper (core) ball is also released for 2.5D and 3D design for embedded packaging. Paste, such as the NSV type and Flux like WF-6317, JPK8, 901K5 are also products provided for different needs.

As copper (Cu) pillar bumps becomes the lead-free-drop replacement for solder bump, making it the flip chip interconnect choice, SMIC believes that as fine pitch keeps going, Cu pillar can help handle problems such as EM. Nevertheless, Cu pillar still has process difficulties. The company always tries to find new methods to overcome current obstacles and will also strive to find possible method to help deal with the bumping process.

Taiwan is an important market for SMIC, it being the largest consumer of semiconductor materials due to large foundry and advanced packaging base. SMIC does not only give suggestions for materials application but also provide technical help (such like abnormal root cause analysis, superior quality and prompt service) if necessary. Whenever customers have demands for new design or better, SMIC usually cooperates to find the best solution. Besides, Senju Taiwan also is a member of SEMICON Taiwan assembly and testing committee.

In terms of light-emitting diode (LED) wafer business in Taiwan, LED packaging gradually changes from WB to FC or other new packaging methods. Cost is a tougher issue in the industry. Moreover, the alloy which is adopted by the LED industry is mainly silver, which makes cost an even harder obstacle to climb. For the time being, the change of LED packaging still does not contribute to SMIC's business, but is always willing to provide its experience and technology should the need arises.

SMIC also participated at this year's SEMICON Taiwan and identified 3D packaging, smartphone, and fine pitch bumping formation technology (below 100μm) as themes for the event. For each item, the company also proposed materials for different applications. The products include solder ball, paste, flux, chip solder, copper (core) ball, PPS and so forth, and the three trends. SMIC received many inquiries at the show regarding these aspects and have begun some new projects recently.

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Manufacturing Trends for Small Parts

Mounters Cater to Ultra-Small Parts, Finer Materials

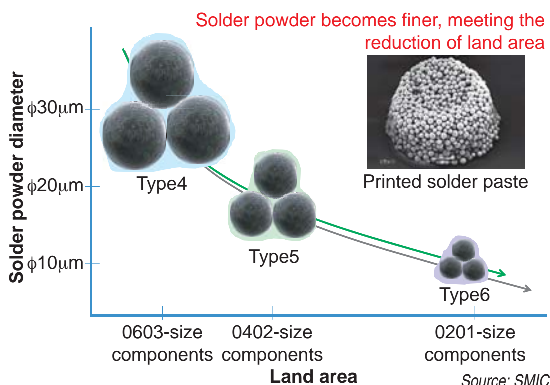
Japanese mounter makers are now gearing up to accommodate ultra-small components, while solder makers focus on using finer powder materials for tiny parts.

Japanese electronic components manufacturers have been advancing the development and commercialization of electronic components that are smaller than the 0402-size (0.4 × 0.2 × 0.2mm). Mounter and solder manufacturers have been advancing measures to mount ultra-miniature components on printed circuit boards (PCBs) and module substrates by applying surface-mount technology (SMT).

0201 Components Introduced

At CEATEC JAPAN 2013 held in October, electronic components manufacturers introduced many latest ultra-miniature components, such as the 0201-size (0.25 × 0.125 × 0.125mm) components, including reference exhibits.

The volume of 0201-size components is about one-fourth that of existing 0402-size components. They will further advance in size reduction, enhancement of functionalities, and the reduction of power consumption of modules in smartphones and tablet computers. In order to accommodate ultra-miniature components using SMT, mounter manufacturers have been advancing the development of parts, such as heads, and solder manufacturers have been advancing the development of finer materials, such as solder powders (Fig.).



Solder paste for 0201-size chip components

Mounter manufacturers have been developing heads and other parts that accommodate mounting of ultra-miniature components.

Fuji Machine Mfg.'s video footage for the demonstration of mounting 0201 components.

Using a solder printer, solder is applied on locations of PCBs, where components are to be mounted. Meanwhile, a mounter sucks components fed by a feeding system through the nozzle (head) of the mounter and mounts them on targeted locations on the substrate. Then, the solder is melted by a heating system to join components onto the substrate.

Mounting Accuracy of ±25μm

Fuji Machine Mfg. Co., Ltd. accommodates 0402-size and smaller components through its latest mounter, NXTIII, of the NXT Series, for which the company has a track record of shipping 42,000 units worldwide. The company began receiving orders for NXTIII last September.

The company offers various units compatible with the NXT Series, including an auto head cleaner that contribute to automation and labor savings.

NXTIII accommodates mounting of components down to the 03015-size (0.3 × 0.15mm) in terms of nominal value, using a special head. Adopting the company's original servo control technology and component image recognition technology, NXTIII mounts components with mounting accuracy of ±25μm.

Panasonic Factory Solutions Co., Ltd. (PSFC) intends to meet the needs for the mounting of 0201-size components using the NPM-D2 production modular. At present, it can mount components down to the 0402-size using 16-nozzle and 12-nozzle heads.

According to PFSC NPM-D2 is capable of securing basic performance in present prototyped 03015- and 0201-size components. PFSC will conduct verifications to ensure stable quality, including the solder, nozzle, and feeder, toward stable mounting in mass production at actual production sites.

10μm Ultra-Fine Powder

Senju Metal Industry Co., Ltd. (SMIC) has developed M705 RGS800 Type 6 solder paste for the mounting of 0201-size components, and halogen-free-specification M705 RGS800HF Type 6. SMIC has used 10μm ultra-fine powder instead of 30μm powder, which has conventionally been used as a typical powder. As solder alloy, the company has used an industry standard M705 lead-free solder alloy.

"The (M705 RGS800 Type 6 and M705 RGS800HF Type 6) solder pastes accommodate mounting of 0.2mm-pitch flip chips, in addition to 0201 chip components. We have begun to offer samples to users that are producing module substrates, and plan to commence mass production within 2013," notes a staff from SMIC. ❑

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Senju Metal Industry's Solder Pastes Cater to 0201 Chip Components

The solder pastes, which come in two kinds, adopt 10μm powder and feature optimized viscoelasticity for uniform and stable supply of solder.

Senju Metal Industry Co., Ltd. has developed two types of solder paste for mounting 0201 chip components (0.2 × 0.1mm): M705 RGS800 Type6 and halogen-free M705 RGS800HF Type6.

Ultra-small 0201 chip components are significantly smaller than 0402 chip components (0.4 × 0.2mm) that have been already used in smartphones and other devices. Some component manufacturers have announced that they will bring 0201 chip components to the market next spring.

The M705 RGS800 Type6 solder paste has adopted extremely fine powder with a diameter of 10μm rather than using 30μm powder that has been commonly used as solder powder. Optimized viscoelasticity of solder paste has enabled fairly stable and uniform supply of solder even for an opening size of 100μm and a mask thickness of 40μm that are based on the assumption of mounting 0201 chip components.

It is known that solder paste using finer solder powder has a larger surface area of powder and an increased amount of surface oxide film, which results in deterioration of soldering. To cope with this issue, Senju Metal Industry has developed a flux for ultra-fine solder powder. As a result, the M705 RGS800 Type6 solder paste has achieved stable soldering.

Solder paste for mounting 0201 chip components

The new solder paste uses industry standard lead-free M705 (3.0% silver, 0.5% copper, and 96.5% tin) for solder alloy. It can be used for mounting not only 0201 chip components but also 0.2mm-pitch flip chips. Senju Metal Industry has started providing samples to module substrate manufacturers and other users, and plans to start mass production by the end of 2013. ❑

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SMIC Shuns Conflict Minerals in Anodes for Plating

Article 1502 of the Dodd-Frank Wall Street Reform and Consumer Protection Act, which substantially prohibits the use of conflict minerals, came into force in 2013. Inspections of the countries of origin of the four target metals, which are used in products, have commenced tracing back commercial distribution.

Tin (Sn) is one of them, and inspections of solder materials, which are generally known as tin products, have been conducted actively. However, inspections of the anode of Sn-based plating have been a blind spot. Although manufacturers of solder materials that are used in one product for the market are limited, numerous manufacturers are plating terminals of components, and it has been very difficult to determine countries of origin of anode. At the same time, there are also risks to overlook conflict minerals.

Senju Metal Industry Co., Ltd. (SMIC) has been selling anodes for electrolytic plating, whose main component is Sn, along with solder materials. SMIC does not use conflict minerals in its anodes as is the case with solder materials. In inspections of customers in the downstream, they can promise 'reliability, security, and safety' simply by conveying that they are using SMIC's anode."

SMIC's anode products

Highlights of SMIC's Anodes (Fig. 1)

① SMIC's anodes are compliant with Article 1502 of the Dodd-Frank Wall Street Reform and Consumer Protection Act as they do not use conflict minerals. In addition, they include only minute amount of lead impurities. As they are managed and guaranteed in a unit of lot, films deposited by plating can be compliant with Pb content of 1000ppm or less, which is specified in the Restrictions on the use of Hazardous Substances (RoHS) directives of the European Union (EU). Hence, it is not necessary to determine lead (Pb) content in the process.

② SMIC's anodes, which are produced by special manufacturing method, feature fine and uniform crystal grains. As they have high conductivity, they require low voltage in order to obtain specified current densities, thus they contribute to energy savings.

③ Fine crystal structure at the same time means a structure with minute amount of oxides between crystal grain boundaries. When Sn of anode is ionized and melts into the plating solution, oxides that are not necessary for the depositing of plating film are discharged into the plating solution. SMIC's anodes with minute amount of oxides discharge trace amount of oxides and hence prevent the contamination of the plating solution. As a result, the exchange frequency of plating solution becomes fewer, and the cleaning process can be eliminated, thus enabling cost reduction.

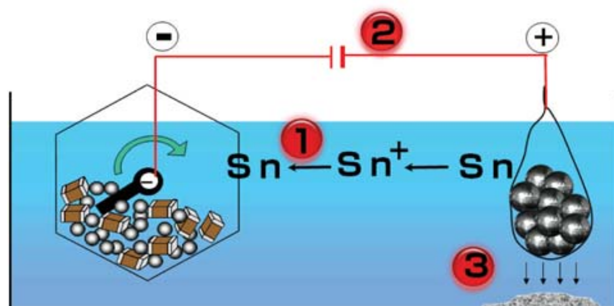

Fig. 1: Three features of SMIC's anode in electrolytic plating

Ingots, in which no conflict minerals are used

Limits Risks to Whiskers

When there are concerns about the improvement of solderability and whiskers, Sn-based alloy plating is recommended.

For example, a general Sn-Bi plating uses Sn for anode, and bismuth (Bi) is added at fixed intervals by adding replenishing liquid that contains Bi. Hence, Bi concentration changes and constant amount of Bi cannot be deposited. Sn-Bi plating has large variations in alloy composition. In addition, as it uses expensive replenishing liquid, Sn-Bi plating is costly. Bi is not uniformly distributed in the deposited Sn-Bi plating film, and the risk of whiskers is not suppressed.

SMIC proposes Sn-Bi alloy anode in order to solve this problem. Sn-Bi alloy anode does not require replenishing liquid that contains Bi, and Bi contained in the anode is continuously supplied and deposited in the plating film. In addition, as Bi is supplied from the anode, constant amount of Bi is deposited at all times, and a film with little variation can be formed. Bi in the continuously deposited film is more uniform than Bi deposited from replenishing liquid, and therefore, it suppresses the risk of whiskers.

SMIC's anodes are conflict minerals-free, compliant with RoHS, and achieve energy savings, and cost reduction. ❑

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