Achieving Thermal Control for Power Devices:  
Die Attach Solder Pastes for Varying Requirements

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Not only are today’s package designers and assemblers faced with the inherent design and functionality challenges associated with smaller device footprints and higher I/O counts, but they must also ensure that proper thermal control is built into advanced electronics packages. In fact, heat management for modern power semiconductor devices such as rectifiers, power transistors, amplifiers and countless other consumer and automotive applications is one of the most pressing issues facing the packaging industry. As these packages marry smaller outlines with higher functions, ensuring efficient thermal management will be key to long-term reliability and performance.

Traditionally, silver-based die attach adhesives have been used to assemble these leadframe devices, whereby a bondline is formed and heat transfer is achieved via an epoxy/silver stacked matrix. Even though the thermal resistance is good, the technology is a decade older than newer-generation solder based systems. While it is an acceptable production method, it is certainly not the most cost-effective or efficient approach to heat transfer. Another commonly used material is pure solder wire. Solder wire is prepared in a clean environment to ensure material integrity. During processing, the solder wire is drawn onto the die and flux-free chip soldering takes place under vacuum and/or under an inert atmosphere. When the inputs into this process are perfectly controlled, it is effective. But perfection is difficult to achieve and there is little margin for error: the purity of the metal throughout the wire must be guaranteed and the environment in which you are performing the solder bonding must be absolutely controlled to avoid any corrosion. Plus, as the industry moves toward miniaturization and finer and finer deposits which dictate precise control, solder wire will likely not emerge as the optimum medium, as repeatable sub-micron deposition volumes will be difficult at best using solder wire.

Driven to find alternatives to current processes and materials, packaging specialists are now focusing on die attach solder pastes as the likely die attach material of choice for leadframe power semiconductor devices. These materials offer the thermal management required, while also delivering the user friendliness and versatility associated with solder paste materials. Because these packages will travel through very high temperature processes during printed circuit board (PCB) assembly, the solder used for die attach applications must have a high melt point to ensure component stability during PCB assembly. The latest products in this class of materials, Henkel’s Multicore DA100 and Multicore DA101, offer two robust options for varying thermal requirements. Available with a wide range of high-lead and non-lead solder alloys, Multicore DA100 and Multicore DA101 have been optimized specifically for high temperature processes in excess of 350°C and, therefore, ensure no adverse effects on the molded package. Multicore DA100 is designed for syringe dispense applications while Multicore DA101 is designed for printing. So, whatever your process or application dictates, Henkel’s solder die attach portfolio delivers.

Other drivers for advances in die attach solder paste development include paste wetting adaptability and void reduction. While the majority of today’s leadframe finishes are copper, alternative metallizations are emerging on new package designs. So, not only will the die attach solder pastes used have to provide excellent wetting to copper, but they must also be versatile enough to deliver good wetting performance on NiPdAu and Ag finishes as well. Both Multicore DA100 and Multicore DA101 are adaptable materials that have exhibited excellent wetting
ability to a variety of surfaces, giving packaging specialists the manufacturing flexibility and supply chain simplicity they require.

Last, and perhaps most important, is the die attach solder paste’s performance in relation to void formation. Reduction of voids is essential to efficient thermal transfer and overall device reliability. And, while the PCB assembly market has put an aggressive target on void levels of less than 5%, the packaging industry hasn’t been quite as strict. In fact, satisfactory levels of void instances are largely based on customer requirements and, in the semiconductor packaging market, that figure has generally hovered between 10% and 20%. But, as we have learned in the PCB market, while some voiding may be considered “acceptable”, having fewer voids means stronger interconnects and a more robust product. The presence of voids in the die attach or solder may restrict thermal and electrical flow between the die and circuit board. This may result in a general performance degradation or catastrophic failure where localized hot spots occur at the void, resulting in thermal avalanche.

Built on Henkel’s successful low-voiding PCB assembly solder paste platform, Multicore DA100 and Multicore DA101 have been optimized to deliver extremely low voids. In testing against other die attach solder materials, Multicore DA100 and Multicore DA101 exhibited significantly lower void instances, averaging less than 2% voids and delivering a level comparable to the performance of the company’s low-voiding assembly solder pastes. This low void level is a considerable improvement over competitive products, offering packaging specialists the opportunity to further reduce voids by an additional 8% to 18%. In addition, the materials provide ease of cleaning, with flux residues quickly and thoroughly cleaned with a variety of off-the-shelf cleaning chemistries. The unique flux system of the product maintains the integrity of the copper leadframe, with no copper degradation or corrosion post-cleaning.

Besides the high quality and unparalleled performance of both Multicore DA100 and Multicore DA101, Multicore DA100 has also proven ideal for high-productivity requirements. Dispense speeds of more than three times the typical levels have been achieved in production. But that’s not all; the material also delivers excellent pause-time, dot-to-dot consistency and extended pot and storage life.

All of these important materials characteristics – low voiding, cleaning simplicity, high reliability and high productivity – will be essential for leadframe die attach materials as the industry transitions toward higher density, smaller footprint, increased functionality devices. Multicore DA100 and Multicore DA101 deliver these benefits now, enabling packaging firms to move their miniaturized products into cost-effective mainstream production. For more information on these products or any of Henkel’s advanced packaging materials, call the company’s headquarters at 949-789-2500 or log onto www.henkel.com/electronics.