Across the 5G Spectrum:

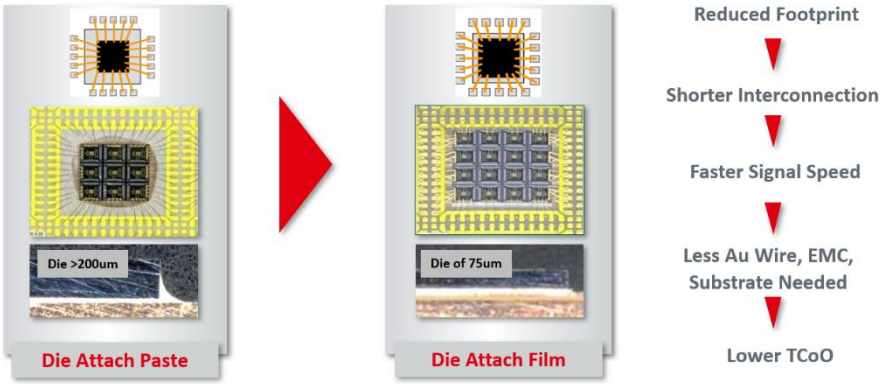
Next-Gen Broadband Technology Driving Complex Package Designs, Reliability Demands and Material Capability

While consumers most often associate 5G wireless communication with improved connectivity and exponentially faster download speeds for smartphones, the next generation of mobile broadband technology will impact far more than mobile devices. Home broadband services, for example, enable faster internet and a more robust experience for entertainment, smart home capability and home office connectivity. In the healthcare sector, 5G can improve telemedicine, facilitate remote monitoring, and provide more positive outcomes with virtual reality physical therapy. And, perhaps most impactful is automotive technology, with 5G contributing to the rise of autonomous vehicles and near-immediate response times through low latency vehicle-to-vehicle communication. Other markets such as industrial manufacturing, energy, infrastructure and consumer electronics also stand to benefit from 5G.

The 5G chipsets used to deliver sub-6 GHZ and mmWave (30 to 300 GHz) broadband access are increasingly complex. Chipsets – the groups of integrated circuits that collectively enable the 5G experience for a particular application -- leverage the latest advances in semiconductor technology to facilitate package designs that incorporate more die into increasingly integrated devices. Within this framework of increased function, thinner packages and challenging footprints, die dimensions, quantity and density, as well as novel semiconductors like Gallium Nitride (GaN), are making 5G capability possible. All of these factors combined, however, may require a move away from conventional die attach material solutions to facilitate a higher quantity of thinner die (as thin as 50 µm), closer die placement and the thermal control required for higher operating temperature GaN semiconductors, particularly for high reliability RF applications. What's more, maximizing cost-efficiency is always a priority, so achieving device capability while maintaining competitiveness is a prerequisite.

Tighter Dimensions, More Control

Traditionally die attach paste materials have been the technique of choice for securing semiconductor die to their corresponding substrate. While this approach will continue to dominate for many semiconductor packaging applications, the move toward more integrated designs with multiple dies per device in combination with the requirements for higher reliability and reduced cost are moving many packaging specialists toward conductive die attach film technology.



Across multiple applications and integrated packages, conductive die attach film is enabling continued miniaturization and delivering more design and processing latitude for high-density, system-in-package components. As compared to conductive die attach paste, conductive die attach film is superior in many respects: film adhesive eliminates concerns with die tilt, provides consistent bondline control and use

across die sizes, and eliminates the fillet, allowing tighter die placement while requiring less Au wire for wire bonding.

Not only does die attach film enable more advanced designs, it also reduces total cost of ownership due to several factors, including:

- Footprint reduction of >50% allows package quantity to be reduced; many packages can be reduced to one using multiple die.
- Alternative to SoC designs, where expensive masks are required to construct a single, large die with many functions. Instead, less costly individual chips can be used for analog, digital and RF functions and, with film, can be placed closer to each other for faster functioning.
- Tighter die to pad ratios for SiPs allow higher UPH, as well as other cost-down benefits:
    - Reduced leadframe costs
    - Lower Au wire costs per I/O
    - Less mold compound per unit package

High Reliability for High Performance 5G

All of the aforementioned benefits of conductive die attach film from a design perspective are well-documented. However, tight design is not the only consideration – particularly for high performance 5G broadband applications. Specifically, when one has to bridge the gap of more die integration and high reliability say, for automotive power management devices or a high-performance 5G RF transistor, conductive die attach film is the clear choice. In fact, some conductive die attach film materials are delivering even on demanding automotive grade 0 reliability standards (**see Table 1 below**), as is the case with Henkel's LOCTITE® ABLESTIK® CDF 500P series materials, which close the divide between dimensional challenges and thermal cycling reliability.

AEC Grade	TCT	HTS
Grade 0	-55C to 150C for 2000 cycles or equivalent	150C for 2000 hrs or 175C for 1000 hrs
Grade 1	-55C to 150C for 1000 cycles or equivalent	150C for 1000 hrs or 175C for 500 hrs
Grade 2	-55C to 125C for 1000 cycles or equivalent	125C for 1000 hrs or 150C for 500 hrs
Grade 3	-55C to 125C for 500 cycles or equivalent	125 for 1000 hrs or 150C for 500 hrs

Table 1: Automotive Grade reliability testing requirements.

The ability to meet the stringent thermal cycling requirements of the automotive grade 0 standard is why many 5G applications – automotive chip sets among them – are using conductive die attach film materials like LOCTITE ABLESTIK CDF 500P series products. With this solution, the challenging design parameters as well as electrical and thermal conductivity are met, enabling new 5G solutions to be brought to market. And, for other applications there are many Henkel conductive die attach film solutions that deliver on AEC grades 0, 1, 2, and 3 standards.

In application, several Henkel conductive die attach film materials have already proven their success for 5G designs with excellent results. A recent example includes a 5G RF transistor for a wireless base

station unit. Replacing die attach paste with Henkel's conductive die attach film, the customer was able to:

- More than double the thermal cycling reliability as compared to die attach paste
- Reduce package dimensions, while improving functionality
- Facilitate the use of very thin die

And, this is just one of many examples. 5G applications will be transformative for the way we live, work and play. Henkel conductive die attach films are helping advance 5G designs for cost-effective speed, reliability and performance. To learn more, contact our team.

Info

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