Conductive Die Attach Film Enables Robust Production of GaAs-based Wireless Devices

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Many of today’s optoelectronics, photovoltaic, and wireless RF electronics applications are manufactured with Gallium Arsenide (GaAs)-based devices. Whereas silicon (Si) is the more commonly known wafer material for semiconductor products, GaAs offers better performance as compared to Si for specific applications. Among other distinctions, GaAs-based devices have higher carrier mobilities than Si-based products, making them more capable to respond with the higher switching speeds needed for RF devices. This is critical for telecommunication applications. The rapid growth and adaptation of wireless devices has made the need for continued development of GaAs-based small form factor packages even more important.

GaAs wafers are much smaller than Si wafers, and are generally 100 mm, 150 mm or 200 mm in diameter. 100 mm and 150 mm are the norm and make requirements to utilize the surface area extremely stringent. Because GaAs devices dies may be much smaller than Si-logic devices, there are often numerous dies per wafer with very tight distribution, making conventional blade wafer dicing exceptionally challenging. This, in addition to GaAs wafers more brittle nature as compared to Si, make laser dicing techniques preferred to blade dicing so as to reduce cracking and facilitate the narrow die spacing. Recent advances in laser and optics technologies have enabled laser dicing equipment manufacturers to develop systems that offer through-thickness cutting of 100 µm thick GaAs wafers with very narrow kerf widths.

Not only do GaAs wafers require different dicing techniques, but they can also benefit from the use of newer dicing die attach materials. As compared to traditional die attach paste, conductive die attach film (cDAF) can help reduce material cost and improve the package quality of GaAs devices. Unlike paste-based materials that can cause die top contamination when they move out from under the die, cDAF’s semi-solid state maintains the material's position with minimal squeeze out. Additionally, the thickness of cDAF materials is completely controlled and specified with different formulations, therefore delivering precise bondline control which is especially important for wafers thinner than 100 µm, a normal thickness for GaAs wafers. Film-based die attach materials also enable tighter die-to-die spacing, offering tighter die to pad clearance which allows for more die per package. This is a key advantage for communications manufacturers where adding multiple devices on the same pad helps push the functionality envelope even further. The pad real estate required with cDAF as compared to die attach paste materials is also much less due to cDAFs low degree of squeeze out. This also aids in functionality as it allows for shorter interconnections within the package, which increases the device frequency – an important consideration for communications products.
Recently, DISCO and Henkel conducted a series of evaluations to test the viability of conductive die attach film when used in combination with laser dicing of GaAs wafers. Using Henkel’s LOCTITE CDF 200P and LOCTITE CDF 800P conductive die attach films, both in 15 µm thicknesses, the team analyzed the viability of laser dicing of GaAs wafers using a DISCO DFL7160 laser saw. 100 mm GaAs wafers with various backside metallizations were used. Wafers were thinned to 100 µm using a wafer grinding process and were then mounted on LOCTITE conductive die attach film for dicing into 1.0 mm x 1.0 mm dies. All of the evaluated wafer types were successfully diced using the DISCO laser saw and the Henkel cDAF materials. Following dicing, the dies were mounted onto leadframe substrates and encapsulated for cross-section analysis and MSL reliability testing.

Examination of the die sidewalls under optical microscope and SEM confirmed that there were no micro-cracks present at the die edges. In addition, no die breakage or delamination of the cDAF under the die was observed; the bulk cDAF was not impacted by the laser dicing process. Finally, MSL 1 reliability test results indicated the substrate to GaAs die bond maintained high adhesion and low moisture absorption.

As wireless devices continue to reduce in size and increase in function, the use of GaAs-based die will accelerate. Henkel and DISCO have shown that incorporating cDAF materials in combination with through-thickness laser dicing is a feasible and effective approach for GaAs device package fabrications.

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