



APPLICATION INFORMATION

Anti-Bleeding Protection Layer for LEDs by PlasmaPlus®

Avoiding the bleeding of epoxy and hybrid die attach materials while improving the reliability by enhanced wire pull forces

The long term reliability of an LED package depends firstly on the proper material choice. Namely the package material, the encapsulants and die attach materials have a big impact and must be adjusted to each other.

But even in the case of a suitable material choice, some features of the materials applied require additional processes like cleaning steps.

The reliability of the wire bond for example depends strongly on the surface quality of the bond area metallization prior to the thermosonic bonding process. Contaminated surfaces lead to reduced bond strength and are one of the main causes for LED malfunctions by losing electrical contact. The most common reason for contaminated wire bond areas is the bleeding out of the chip glue during the cure at elevated temperatures. The removal of glue bleeding is usually done by a low pressure plasma process, where the determination of the process gas depends on the leadframe or board metallization type.

For the cleaning of silver surfaces, a mixture of Argon and Hydrogen is very common. The drawback of low pressure plasma processes are the high investment costs in equipment, the long treatment times up to 30 minutes and the need for a proper cleaning of the reaction chamber to prevent cross contamination, for example of copper ions.

By applying a protection layer generated by PlasmaPlus®, it is possible to avoid glue bleeding and to increase the wire bond force at the same time. A layer in the magnitude of a few nanometers changes the surface energy of the silver surface in a way that prevents bleeding efficiently. The layer does not generate additional electrical resistance and can be easily removed during the thermosonic bonding process.

Test with forced glue bleeding

The picture below shows the anti-bleeding effect of the PlasmaPlus® layer. Bleeding of the silver filled epoxy glue has been forced during this test by applying a staging time of 30 seconds at 60°C prior to curing at 160° C.

To examine the reliability of wire bonds after application of the anti-bleeding layer, a combined 5600 series wire bonder and tester from DELVOTEC was used as test equipment.

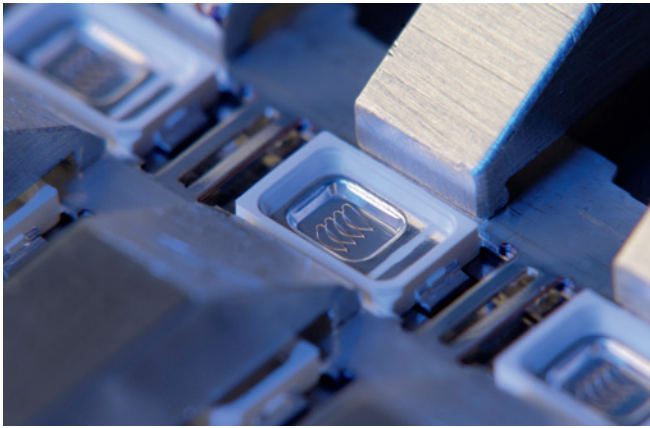
Anti-bleeding effect of PlasmaPlus® using a 5730 package type by I-Chiun



untreated leadframe



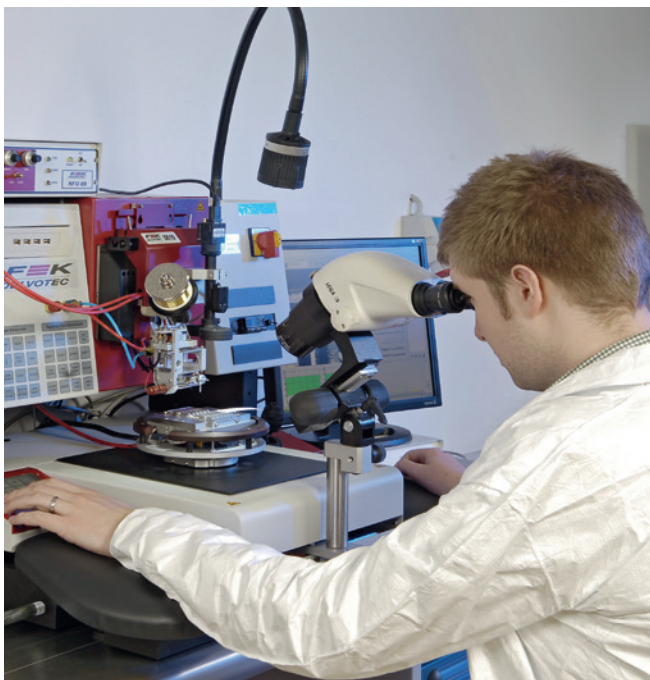
PlasmaPlus® anti-bleeding layer



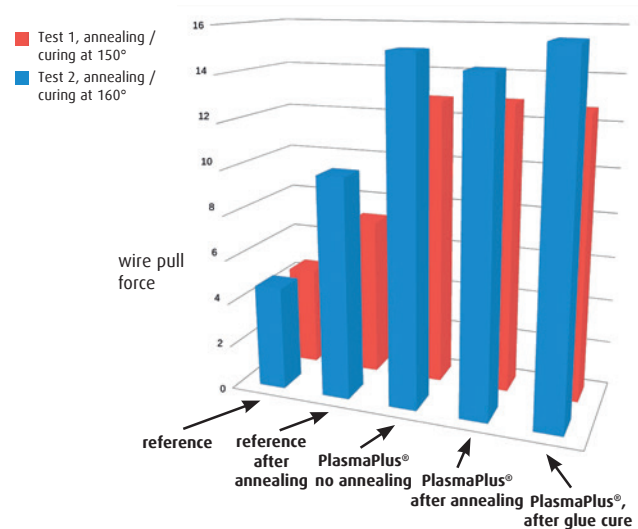
Wire bonding as test tool to judge the influence of the PlasmaPlus® layer on the wire bond reliability

The wire bonding can be used in a way to distinguish between clean silver surfaces and contaminated surfaces and to judge the quality of the anti-bleeding layer. A set of bond parameters, that will provide stable bonding for clean surfaces, may give insufficient results in the case of contaminated surfaces. The measure for the bond quality is the maximum wire pull force applied until destruction of the wire bond.

The application of the anti-bleeding layer increases the wire bond forces compared to uncoated leadframes in a significant way. The results have been confirmed by multiple repetitions using the same parameters but different leadframe batches and different curing temperatures.



Testing the anti-bleeding layer quality by wire bonding



Effect of the anti-bleeding layer on wire pull forces under variation of the curing temperature

The strongly improved adhesion between bonds and the silver surface has been verified by shear tests that showed always significant gold remnants on the leadframe, ensuring that the reason for the enhanced wire pull force is the better quality of the silver surface and not caused by mechanical clamping due to roughness. The anti-bleeding layer can be applied to any type of premolded LED leadframe as well as to ceramic boards or MCBs.

All evaluations have been carried out on a AS400 Plasmamatreat coating unit. This design is suitable for leadframes in strip form and can be expanded to a magazine handling system. A modification of the system for a reel to reel process is possible.



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Subject to technical changes and misprints.