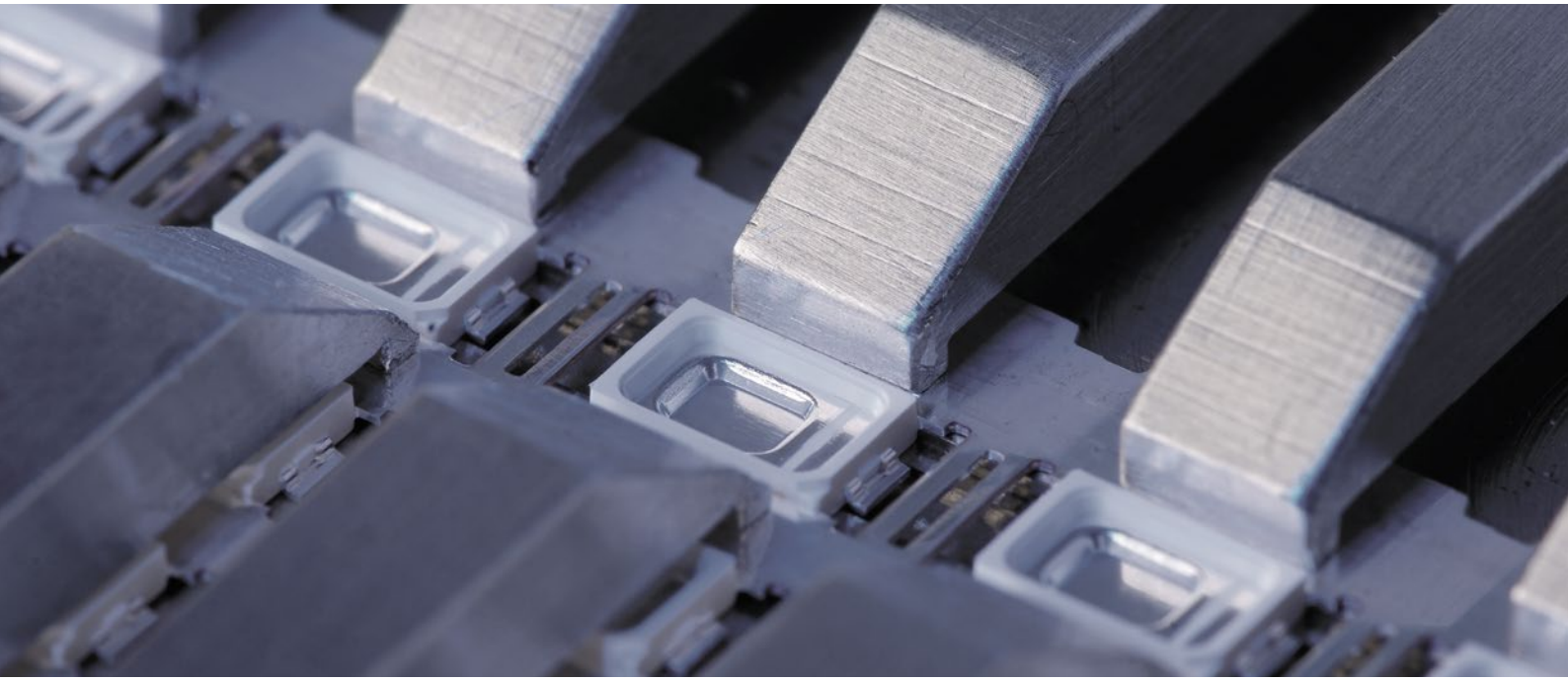
plasmatreat



APPLICATION INFORMATION

Corrosion Protection in LED-Production by PlasmaPlus®

Nano Coatings based on PlasmaPlus® technology protect silver surfaces from H_2S corrosion

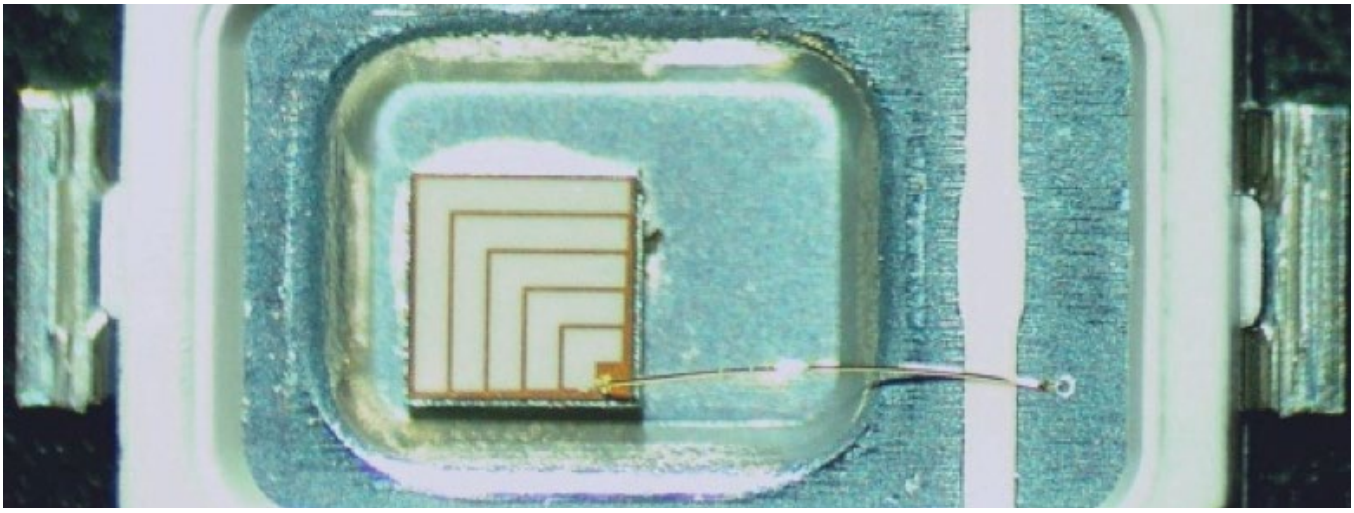
The lifetime of an LED is strongly influenced by the ambient conditions, under which it is operated. In applications where LEDs are exposed to a corrosive atmosphere, such as in lighting or automotive applications, long-term reliability and maintenance of luminous efficacy are an absolute must. Since about 10 years, the light output of blue emitting emitting chips has reached a level that, under operating conditions lead to rapid yellowing of epoxy-based encapsulation resins. Due to their high stability against short-wave light and high temperatures, silicones have been used for years as potting resins for white and for white and blue emitting LEDs.

But silicones exhibit a high permeation level for all kind of gases due to the polymer network properties. Some gases, such as hydrogen sulfide or nitrous gases, attack silver and lead to corrosion effects over time. Besides the loss of reflectivity, the corrosion of the silver surface of the wire contact pad causes a lift of the bond, resulting in a malfunction due to interrupted electrical contact.

In order to avoid corrosion effects, the LED manufacturers are changing the plating of copper leadframes from silver to Nickel/Gold or to Nickel/Palladium/Gold.

The application of a PlasmaPlus® layer inside the LED after die and wire bonding prior to the encapsulation process enhances significantly the LED lifetime by preventing corrosion effects or slowing down them to an acceptable level.

Application of the PlasmaPlus® layer on an 5050 type LED-leadframe



5630 package type LED with chip and wire before silicone casting

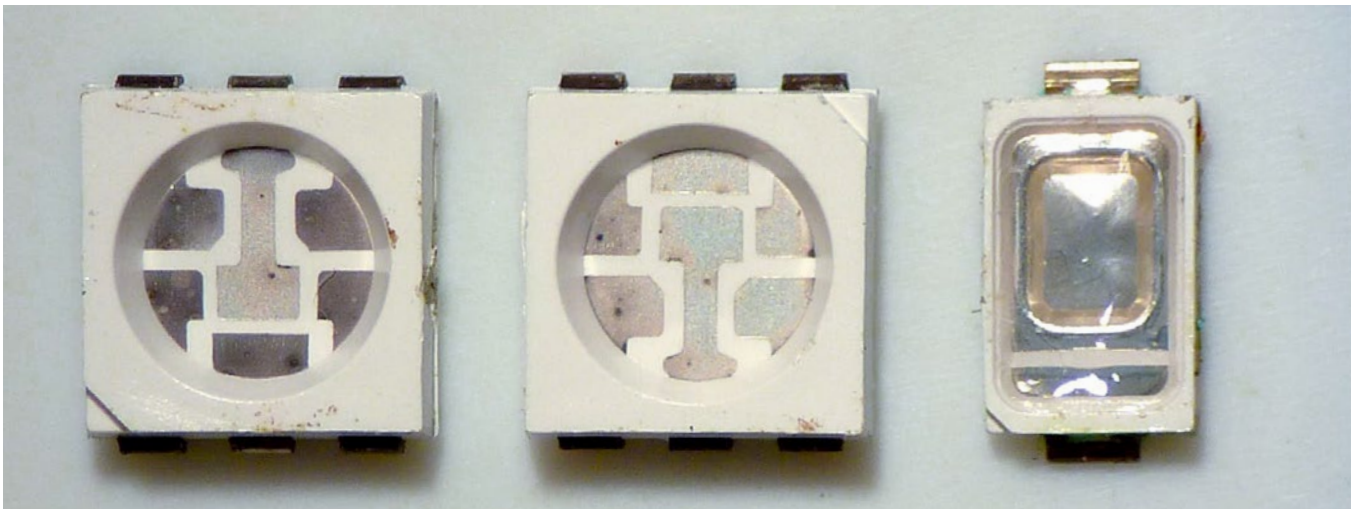
The protection layer is applied by treating the LED package after die and wire bonding by PlasmaPlus®. Here, specific additives are introduced into the plasma via a special nozzle head. These are excited by the plasma. Their reactivity is significantly increased. This enables the substances to attach themselves optimally to the material surface during plasma coating and to bond firmly. Using a high silane flow per hour generates a layer on the surface that exceeds 100 nanometers.

The densification of the layer can happen during the silicone cure or in advance. A densification of the layer prior to silicone casting has shown a better protection by a more complete densification of the layer. By applying a PlasmaPlus® layer, the LED manufacturer can use silver leadframe platings inside the LED package, and no more expensive plating variations are required.

The picture below demonstrates the effect of the anti-corrosion layer.

The LED samples have been exposed 4 days to an atmosphere containing 20 ppm H_2S and 76% r.H. under room temperature. The untreated sample on the left shows strong hydrogen sulfide caused corrosion, where the treated package in the middle shows only minor effects. Both 5050 types have not been casted with silicone.

Applying a casting on the pretreated package, as shown for the 5630 package on the right, leads to no traces of hydrogen sulfide corrosion inside the reflector.



LED packages with different pretreatments after accelerated H_2S test
left: untreated, uncasted / middle: treated, uncasted / right: treated, silicone casting

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