TECH TIP 16

EPOXY TECHNOLOGY

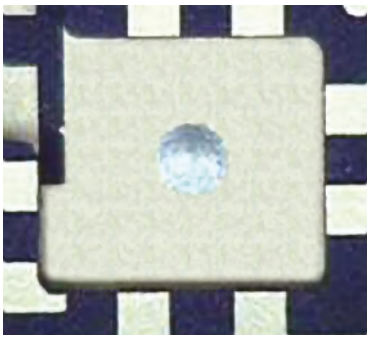
Understanding and Preventing Epoxy Resin Bleed

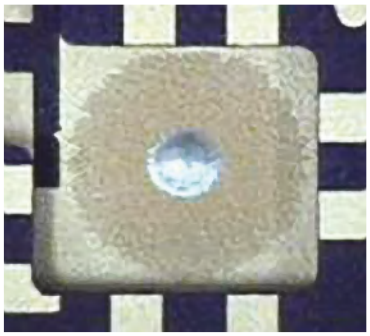
WHAT

Understanding and Preventing Epoxy Resin Bleed

WHY

Epoxy bleed-out is a random occurrence not related to epoxies.





What is Epoxy Resin Bleed?

Epoxy resin separation ("resin bleed or bleed out") is a phenomenon that can take place when working with filled, adhesive systems dispensed onto various surfaces/substrates. It is often described as a clear, colorless or amber organic stain, surrounding the die attach epoxy; appearing as a shadow or a "halo ring" around a circular dot of adhesive. **Figure 1** is an example of what resin bleed may look like.

Resin bleed has, at times, been known to be severe enough to interfere with subsequent wire bonding and lid sealing operations by coating the bonding fingers and seal rings of the carriers. Other times, it is simply a cosmetic/aesthetic concern and its occurrence may be sporadic in nature.

The purpose of this tip is to provide an overview of resin bleed, ways to avoid it and is meant as a general guideline for epoxy adhesive users.

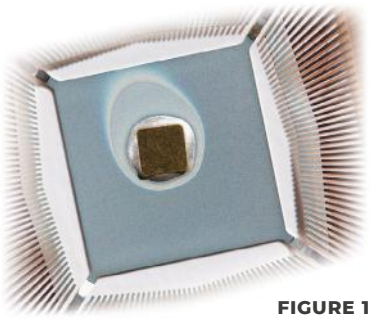


FIGURE 1

What Are Some Potential Causes of Bleed Out?

Bleed out may occur for many reasons including: thermodynamics of wetting (surface free energy), bulk material properties and curing schedule.

Surface Free Energy > Epoxy adhesives are typically formulated to have higher surface energy than their respective substrates and adherents. This positive differential ensures good wetting and stronger bonds. When the reverse occurs, a resin bleed often results due to the epoxy having more of an affinity to the surface, than itself. This is especially true with Au plated electronic parts, as described in the surface contaminants portion of this tip.

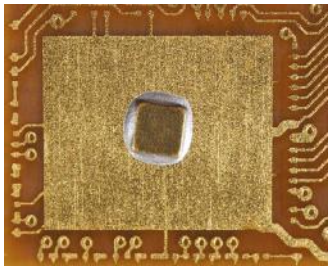
Viscosity of Adhesive > In general, lower viscosity adhesives will bleed more than high viscosity pastes, due to capillary and thermodynamic work of adhesion forces which increase wetting across the surfaces. Differences in densities, wide ranges in molecular weight distribution and type or lack of rheological fillers, can contribute to resin bleed.

Curing Schedule > Do not delay the cure or "stage" the adhesive while on a substrate. This will increase the chances of bleed out. The cure temperature should always be the highest that the substrate will allow; since the faster the epoxy adhesive cures, the lower the probability of resin bleed. As a rule of thumb, higher/faster cure = less resin bleed.

Surface Contaminants > In the manufacturing of electro-plated parts (particularly gold), the plating bath can often be a source of contamination. During this process, the parts are exposed to organic and inorganic agents within the plating bath. These materials can

become entrapped within the plating material as it is being deposited. Even after a solvent cleaning process which parts go through prior to shipment, these contaminants can remain within the plating.

In addition, any solvent residue remaining on the parts can increase the potential of resin bleed down the road. It is also believed that higher porosity substrates may contribute to resin bleed by changing the surface wetting properties, promoting resin bleed through increased capillary transport.



Example of non-bleed on a good Au substrate

What Are the Risks of Bleed Out?

Often, resin bleed is a cosmetic risk only, which may appear unsightly, as poor craftsmanship to end-users. When the resin bleed is severe, this organic layer can interfere with subsequent assembly operations by coating wire bond pads and solder joints as well as lid sealing metallization; leading to electrical and mechanical failures. In today's circuit assemblies, manufacturers are creating smaller packaging, bringing wire bond pads and lid sealing metallization even closer together. Even minor resin bleeds can cause a major impact on performance.

Substrates Most Often Affected

- Usually gold (Au) pads on PCBs and substrates
- Lower quality substrates/poor plating processing
- Porous substrates such as ceramics and crystalline silicon
- Die-paddles used in semiconductor lead frames.

How to Prevent Bleed Out?

General > It is important to remember that resin bleed is not an epoxy phenomenon, but a substrate dependent one. Therefore, substrate quality is of the utmost importance. Each lot of incoming substrate should be screened for resin bleed (via a simple dotting test; bleed out is usually seen within the first 10-30 minutes) prior to production assembly. Any substrates not passing this test should be quarantined, while a new lot is investigated.

Vacuum Bakeout > For consistent and best performance, each substrate lot should be vacuum baked to ensure a properly prepared bonding surface. Best vacuum baking parameters are 220°C for 2-4 hours at 100 millitorr vacuum. Interestingly, neither a high temperature bake out nor a vacuum treatment alone is effective in eliminating resin bleed; but a combination of heat and vacuum is required for best results by removing both trace cleaning agents and any contaminants.

Plasma Cleaning > Plasma cleaning involves the removal of impurities and contaminants from surfaces through the use of an energetic plasma created from gaseous species. Gases such as argon or oxygen, are commonly used.

However, if the plated part to be treated is easily oxidized, such as silver or copper, inert gases such as argon and helium are preferred. The plasma activated atoms and ions behave like a molecular sandblast and can break down organic contaminants.

As a side note, plasma cleaning (also known as plasma etching) is most often used to treat fluoropolymer-based materials, like Teflon®(PTFE), that are difficult to bond as it is able to etch the surface and increase adhesion forces.

Plasma cleaning is also effective for removing or "burning off" the epoxy bleed out after die attach, prior to wire bonding, with a low pressure argon plasma, when vacuum baking is not feasible.

CONCLUSION

- **Epoxy bleed out is a random occurrence, not related to epoxies**
- **Au is not always Au in terms of potential manufacturing variances**
- **Not properly preparing and cleaning surfaces can lead to resin bleed**

RoHS COMPLIANT 2002/95/EC

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REACH COMPLIANCE

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