Fabrication Notes

The Prevention and Removal of Absorbed Chemicals in Ceramic Filled PTFE Composites

RT/duroid® 6000 Series, RO3000® Series, and RO3200™ Series High Frequency Laminates are polytetrafluoroethylene (PTFE) composites containing a large volume fraction (>50%) of ceramic filler particles. The high filler loading provides RT/duroid 6002, RO3000 series, and RO3200 series laminates with a low Z-axis coefficient of thermal expansion (CTE) for excellent plated through-hole reliability and an in-plane CTE closely matched to copper for good dimensional stability. The filler loading in RT/duroid 6006 and 6010 achieves a high dielectric constant allowing for reduced circuit size.

The material's high filler loading also contributes to approximately 5 volume percent porosity. The microvoids in the composite appear to exist at the filler-PTFE interface but are not detectable in cross-sections, even with scanning electron microscopy. Because of the low surface energy of PTFE and the treated ceramic filler, the microvoids do not result in high water absorption. However, low surface tension liquids such as organic solvents and surfactant laden aqueous solutions can penetrate the pores.

Since PTFE and the ceramic filler are inert to most process chemicals, liquid uptake simply fills microvoids but does not change the physical properties of these laminates. However, it is critical that volatiles that have penetrated the composite be removed prior to exposing the boards to high temperatures (e.g. bonding operations, Sn/Pb reflow, etc.) Parts should also be thoroughly rinsed immediately following exposure to process chemicals to ensure that non-volatile dissolved materials are not left behind when the parts are baked.

Volatile Removal

Failure to remove volatiles prior to high temperature operations such as bonding or reflow can result in dielectric blistering or delamination. The following baking procedures have been found to eliminate volatile related problems during high temperature exposure.

Basic Guidelines for Baking

1. *Prior to bonding.* Bake fabricated inner layers for at least 1/2 hour at 300°F under vacuum or nitrogen prior to bonding. If the boards are bonded in an autoclave, the bake cycle can be included at the front end of the bond cycle. No pressure should be applied.

2. *Prior to electroless copper.* Bake boards for at least 1 hour at 300°F under vacuum or nitrogen immediately prior to electroless copper plating. This bake is critical since absorbed glycol ethers from commercially available sodium etchants or alcohol from rinses are very difficult to remove once the multilayer board edges and machined features have been covered by electroless copper.

3. *Prior to reflow.* Bake boards for at least 2 hours at 300°F under vacuum or nitrogen prior to reflow or hot

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air solder leveling (HASL). Following the bake, exposure to flux must be kept to a minimum (<30 seconds) and the bake cycle must be repeated if the boards need to be reworked.

When baking parts in a nitrogen purged bag, nitrogen flow out of the bag is necessary to ensure that volatiles are removed from the bag. Similarly, care must be taken when utilizing a vacuum bag to insure that vacuum lines do not become plugged by the bagging materials. If volatiles remain in the bag they will condense on the parts as the parts cool. This can significantly reduce the effectiveness of the bake. The time required for the oven to reach temperature should be added to the recommended bake time if the oven isn't preheated.

Dielectric Contamination

Failure to adequately rinse these laminates following exposure to process chemicals can sometimes result in dielectric staining or increased dielectric loss. These problems can be prevented by minimizing exposure to very low surface energy solvents which contain non-volatile components and by utilizing good rinsing procedures. For example, the part should not be allowed to soak in resist stripper solutions laden with dissolved photoresist any longer than is necessary to strip the resist. Also, parts must thoroughly rinsed immediately following resist stripping.

Basic Guidelines to Prevent Dielectric Contamination

1. Minimize exposure to low surface energy solvents containing non-volatile components.
2. Dump rinse frequently to prevent accumulation of non-volatile materials.
3. If the dielectric surface is exposed to low surface energy aqueous solutions or water soluble organic solutions containing non-volatile materials, soak the part in hot (70ºF) distilled (DI) water for 15 minutes immediately following exposure.
4. If the dielectric surface is exposed to water insoluble solvents containing non-volatile materials, promptly soak the part in a water soluble organic solvent such as methanol, ethanol, or isopropyl alcohol for 15 minutes and then soak it for 15 minutes in hot DI water.

The information in this fabrication note is intended to assist you in designing with Rogers' circuit materials. It is not intended to and does not create any warranties express or implied, including any warranty of merchantability or fitness for a particular application. The user should determine the suitability of Rogers' circuit materials for each application.

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