

| APPLICATION NOTES

COLOR OF POLYIMIDE MATERIALS

Thermoset polyimide materials have a natural coloration ranging from a pale yellow to a dark reddish-brown color. The final color of laminated material can have a wide variation caused by numerous factors. Some of these factors are discussed here.

Resin Color

The resins used by Arlon are purchased to specific requirements and one of the requirements is the color of the resin solution. The resins are tested and measured by a Gardner Color Scale. The resin used in Arlon 85N has a specification range of 14 to 18 on the Gardner scale. Arlon 35N is a blend of materials. One of the components has a color range of 14 to 18, a second component has a range of 0 to 8, and a third is an amber/brown liquid. A picture of the color scale is shown below. As can be seen in this picture, there can be a lot of variation in the color of the base resin as received at Arlon.

Resin Content and Thickness

Arlon coats this resin onto various styles of glass fabric to produce a prepreg. These range from about 0.001 inch thick to over 0.006 inch thick. Each of these have a different construction of fibers and produce prepreg with a range of resin contents. The range can vary from >73% by weight on the thin fabrics to <32% on the thick fabrics. The resin ratio as well as the thickness will significantly influence the product color with thickness generally producing a darker material. The prepreg is stacked up in layers and cured to produce the laminates. In laminate form, again the color can be significantly influenced by the thickness and resin content. The following picture shows three different laminates with the thicker material on the left to thinner material on the right.

Resin Cure and Oxidation

Polyimide resin also continues to darken with additional thermal cure. The thermal history of the material from resin manufacture, coating and B-staging to make prepreg, and lamination processes can all affect the color of the final product. Any additional processes such as baking or thermal testing could cause the product to become darker.

The resin is also subject to oxidative effects when the material is exposed to air during thermal processing. These effects on color can vary widely depending on the temperature and the condition of the air. A sample that is baked in air at very high temperatures may almost approach a dark brown to black color. The same material baked in a nitrogen atmosphere will still darken to a brown color due to the additional cure that the resin is receiving, but not as dark as the sample in air.

Exposure to Light

Polyimide is also photo sensitive and will darken when exposed to light. The photo below on the left is a sample as etched and the photo on the right is after only a two hour exposure to sunlight.

Summary

Polyimide laminates may appear as many different shades of color. There are many different sources for the variation from the start of the process through to the end that may cause the color to change.

Arlon has tested materials with different color with FTIR, Tg, Dielectric Constant, Dissipation Factor, and others and there are no changes to the properties of the material, except when the color changes due to very high temperature exposure. This will result in an increase in the Tg, flexural strength, and tensile strength. It may cause a reduction in copper adhesion. Arlon optimizes our cure recommendation to provide the best balance of all of the laminate properties. The optimization is based on electrical and mechanical characteristics and not color since color has no effect on the material.

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