FROM THE LAB

NEW!

The Microsection a Work of Art (Part 1)

By Bob Neves

Bob Neves has spent *the last ten years as the director of technical services for Microfek laboratories, an independent test facility. Prior to his tenure at Microtek, Bob worked in quality management and engineering in PWB manufacturing. He currently serves as the IPC's Rigid Board General Committee chairman, Rigid Board Test Method Task Group chairman, Laboratory Qualifications (IPC-QL-653) Committee chairman, Member of DESC's Tiger Team for MIL-P-RRRRR (MIL-PRF-31032, Member of Blue Ribbon Committee for MIL-S-XXXXX (MIL-PRF-5X) and Convertor of IEC TC52 Working Group 10 Printed Wiring Test Methods.*

Microsectioning is the most widely accepted means for analyzing the plated through-hole, Microsectioning is an art form and, like a work of art, it can he great, good or bad. The microsection dates back to day before the printed wiring board (PWB), and is primarily used for metallurgical analysis. The metals industry uses the microsection to evaluate the grain size, structure and quality for a vast array of metals which are mainly homogeneous in nature.

PWBs are about as far from homogeneous as you can get. A PWB is a combination of different types of materials like glass, aramid fibers, kapton, copper, acrylic adhesive, epoxy, polyimide, teflon, solder, etc. Each of these materials has a different relative hardness and, coupled with that of the mounting media (epoxy, acrylic, etc.), makes the PWB microsection one of the most difficult to successfully complete. This process is further complicated by the fact that it is essential to complete microsectional preparation in an area within IO percent of the center of the hole. This is relatively easy on a 0.040" hole, but can be extremely difficult on a 0.006" hole (10 percent is a 0.0012" target range).

The first step in the microsectioning process is selection and removal of the test sample from the production panel or coupon. The removal of the sample is typically accomplished by routing, sawing, or punching. Each of these methods induces mechanical stress to the sample which can cause damage to the PTHs and surrounding insulating materials. Glass fibers are good conductors of force, so mechanical stresses induced during the sample removal process can be carried into the PTH barrel area. While punching or shearing is the easiest method of sample removal, it is by far the worst for mechanical stresses. Routing and sawing both remove material to separate the sample from the panel or coupon.

Once the samples are removed, they must be placed into a sample preparation cup either individually or "gang-mounted" together. Gang-mounting techniques can save a lot of time and cost, but sample alignment is critical as there are now multiple samples on which you must reach the center of the PTH. To accomplish this in a repeatable manner, many companies will use tooling holes and pins to align multiple samples.

The next step is encapsulation of the sample in a mounting media which, for PWBs, is typically acrylic or epoxy based. Acrylic materials are clear and transparent, while epoxies are translucent, with a typically dull-brownish color. Mounting materials allow the sample to be easily handled, and aid in support and retention of sample edge quality during surface preparation. Mounting materials harden by use of an exothermic (heat generating) chemical reaction. The general rule of thumb is the faster a material cures, the hotter it gets and the more it shrinks away from the sample edges. Material shrinkage and unfilled PTHs leave gaps behveen the sample edge and the mounting material. These gaps will cause rounding of the sample edges, and in come cases, the PTH may collapse inward during grinding and polishing, making analysis erroneous or impossible.

Mounting materials are typically combinations of hro or more parts that, when mixed together, begin to harden (cure). The mounting compounds which provide the lowest shrinkage, best edge adhesion and lowest heat of reaction typically take 24 hours or more to cure. By contrast, materials are available which cure in ten to fifteen minutes, but these have a high heat of reaction and high shrinkage ratio (poor edge adhesion). Each mounting systems also has a different liquid viscosity which will change the war the material flows into PTHs.

Acrylic mounting systems are usually a powder/liquid combination and are quick curing (<30 minutes). Epoxy mounting systems are typically liquid/liquid combinations, and range' from quick cure (<30 minutes) to overnight cure (24 hours). Many epoxy resins have some type of inert filler material in them to improve the mechanical properties of the mounting compound. Certain epoxy systems may also require a high temperature environment (60°C to 80°C) for proper curing or to decrease curing time.

The mounting compound mixing step is often taken for granted, but a proper mix "style" will decrease the quantity and size of entrapped air bubbles in the mounting compound. These entrapped bubbles can prevent mounting material from flowing into the holes, and will cause pockets to form which will entrap abrasive particles during subsequent grinding and polishing steps. Too much hardener in the mix will cause undue heating and mounting material shrinkage. If too little hardener is added to the mix, the mounting material may never fully cure. Another area often overlooked is the method of pouring the mounting materials over the samples. The mounting material should be poured from one side of the sample, which will force the compound into the PTHs. If the mounting compound is poured directly over both sides of the sample, air will be trapped in the hole and the holes will not fill.

As a word of caution, we have noticed over the last several years that some acnlic systems adhere so well to the PWB surface that shrinkagk during curing will actually rip away the epoxy resin from the first layer of glass, causing what appears to be a laminate defect. We have also noticed that certain resin systems will vary from batch to batch and have a shelf life which will requiring periodic adjustment of the mixing ratios between the various components.

The selection of the proper mounting material is a critical step to obtaining a good microsection. A careful balance between curing time, viscosity, material shrinkage, cost and processing ease must be evaluated when choosing a mounting system.

Coming in June: Part 2, Grinding and Polishing of the Microsection.