



Probing the World of Microelectronics

PROBE TIPS #17

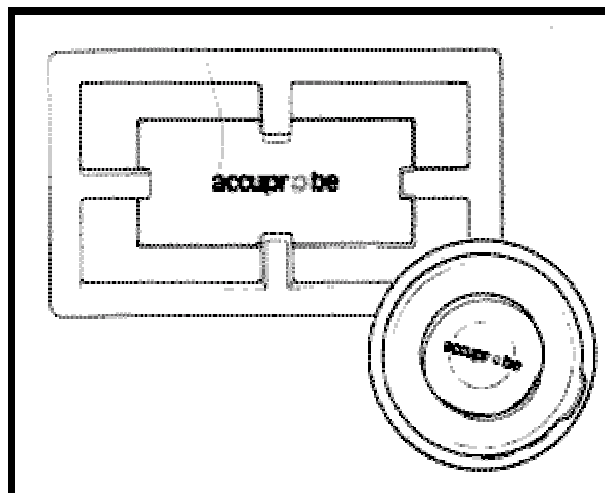
A Technical Bulletin for Probing Applications

Life Expectancy of Probes

Today's business climate requires that we all get the most from what we have, therefore a question which is often asked is "How long will the probe last?". The question is a lot easier to ask than it is to answer. There are many variables in the determination of the probe life. Probes can have a useful life well in excess of a million touchdowns. The life expectancy of probes or probe card assemblies depends more on how they are handled and used rather than the material properties of the probes themselves.

PROBE CARD HANDLING

People damage more probe card assemblies through improper handling or setup than any other factor affecting the useful life of probe card assemblies. Damage can begin right in your receiving/ shipping area. Be certain that when probe card assemblies are received that the container is opened only by someone familiar with probe cards. Packaging plays a critical role in the care and transport of probe card assemblies. Most probe cards are stored in racks where the cards are inserted into tracks for storage. The racks are fine but the card assemblies are still exposed and vulnerable when out of the storage racks. Probe cards should always be stored in an individual plastic probe card protector (PCP). These plastic containers are usually supplied with the Card Assembly or can be purchased separately. Racks can be modified with wider tracks to accept the PCPs. The PCP protects the card assembly while keeping it clean of dust or other airborne debris. Most importantly, the PCP allows someone to pick up and handle the probe card without the danger of inadvertently damaging the probe tips.



The average person not familiar with Probe Cards is typically fascinated with the array of probe needles and is usually tempted to touch the probe tips to see what they do. This can

be fatal to probe cards which are assembled to precision tolerances. Another common mistake is that a person who is handling a Probe Card assembly will, without thinking, simply place the assembly on a table irrespective of where the probes are located. Probe Cards, when placed on a flat surface, should always be placed upside down with the probes pointed up. It is a simple and common sense rule, but you would be surprised how many card assemblies are damaged in this way.

Probe Card Setup

Again whenever the probe card is out of its protective storage container it is vulnerable. Equipment operators should be well trained in handling and setup of probe cards. Before inserting a probe card in a wafer prober or laser trimmer be certain that the device chuck is well below the card mounting area. A common mistake is to slide the probe card in place only to find that the device chuck is up and the tips are wiped out as the card slid into the card holder. It is also good practice to be certain that the prober or laser trimmer has been properly set up for probe overtravel (probe deflection). Absolutely no adjustments should be made to a probe when the card assembly is in the prober or laser trimmer. Operators should never be allowed to "tweak" (adjust) the probes. Card assemblies are precision test fixtures, which cannot be precisely adjusted without proper equipment. Follow the wafer prober or laser trimmer instruction manual for their setup procedure.

Probe Scrub Length

Probes are deliberately designed to scrub the bond pad during contact to break through any surface oxidation and assure a good low resistance contact. The resulting scrub mark allows visual inspection to verify probe alignment. The scrubbing action is what causes the probes to eventually wear out. Therefore, the objective is to reduce excessive scrubbing action to increase probe life. Additionally, an excessively long or large scrub mark could interfere with wire bonding. Controlling prober or handler overtravel is the key to controlling the scrub length and the resulting wear. Overtravel is the additional Z motion of the device chuck or probe card beyond initial probe contact. There is typically a 10:1 ratio of handler overtravel to scrub length. A wafer prober will typically be setup for 1 to 4 mils of overtravel which will produce a scrub length of .1 to .4 mils long. The actual mark on the bond pad will be the size of the probe tip plus scrub length. (See Probe Tips Bulletin on [Probe Mark Analysis](#) for more information) For example, a 2 mil diameter tip with 2 mil overtravel will produce scrub mark approximately 2.2mils long.

Reducing the amount of overtravel will correspondingly reduce the scrub length and increase the probe tip life. The same is true for hybrid laser trim applications. Unfortunately, laser trimmers lack the fine adjustment capability for overtravel as found on wafer probers. However, overtravel and the resulting probe deflection must be controlled to assure long probe life. A typical laser trimmer should be setup for 12 to 15 mils of overtravel it is not uncommon for a trimmer to be running at 25 and even 50 mils or more of overtravel. While it may not be easy, the trimmer must be adjusted to bring overtravel to an acceptable level. Check the laser system handler manual or check with the laser manufacturer before making the necessary adjustments.

Planarization

Probe to probe planarization has an important role to play in determining probe life. If some probes are lower than others they will necessarily scrub longer than the higher probes and therefore wear out faster. (See Probe Tips Bulletin on [The Impotence Of Probe To Probe Planarization](#) for more information.)

PROBE MATERIAL SELECTION

There are three primary materials used today for semiconductor probing applications; Tungsten, Beryllium Copper (BeCu) and Palladium. New Tungsten alloys such as Accuprobe's "Tough Tip" will further extend probe life, but more importantly reduce the need for tip cleaning and will provide stable contact resistance. Material selection should be based on the test application where bond pad material, contact force and contact resistance are the determining factors for material selection. Another key element affecting probe tip wear is the hardness of the tip material and its modulus of elasticity. Tungsten, as a general rule, will last longer due to its hardness (Rockwell 7 C scale) but tungsten contaminates quickly and contact resistance can be undesirably high and unstable. Tough tip alleviates the contamination problem and has the hardness of Tungsten. BeCu has low contact resistance, has only a third the hardness of tungsten and therefore will wear out three times faster. Palladium is softer than BeCu and is relatively one quarter the hardness of tungsten and therefore will have only one quarter the life expectancy of tungsten. Longer probe life can be obtained with any probe material if care and attention is given to how the probe card assembly is handled or used. (See Probe Tip Bulletin on [Probe Contact Resistance](#), for more information on probe material selection.)

ABRASIVE CLEANING WEARS OUT PROBES

One of the big contributing factors to short probe life is frequent abrasive cleaning. Many automatic probers allow automatic abrasive cleaning of probe tips to remove aluminumoxide on tungsten probes. This abrasive cleaning is effectively sanding the probe tips which results in clean tips, but accelerates the wear on the tips. BeCu or Palladium tips typically do not need to be abrasively cleaned since the material is soft and is essentially self-cleaning. It is typically tungsten tips which accumulate Aluminum Oxide in the pores of the extruded tungsten. The new "Tough Tip" Tungsten alloy has a longer useful probe life since abrasive cleaning is not required with the same frequency as the typical tungsten probe. It is possible to reduce abrasive cleaning by a factor of two to three times thus extending the useful life of the "Tough Tip" probes.

CONCLUSION

Probe life expectancy SHOULD NOT be the only or major consideration when selecting probe material. Long probe life is a function of many variables related to handling and use of the probe card assembly as well as the selection of the probe contact material.

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