Micro-Abrasive Blasting
Meets the Challenge of Probe Card Trimming
Application Overview

Using micro-abrasive blasting for probe card trimming reduces labor time and increases accuracy over traditional methods.

Probe cards are used in the testing of semi-conductor wafers to determine a known good or bad die. The production of probe card assemblies is an exacting task. Precise configuration is required for the assembly to be able to perform testing with the high accuracy required. One key area in the building of probe card test assemblies is the final trimming of the probe rings. It is just one step in the manufacturing process, but it is a step that can be quite costly on the production budget if not handled right. This step can determine whether the end result is a good assembly, or whether all the work that went into creating the assembly is lost because of a "slip" in the trimming process.

Probe card assemblies come in various configurations (Figure 1). Probes are assembled in a ring that is connected and soldered to a circuit board that will interface with a tester. A silicon wafer can have up to hundreds of die, and each die has individual pads. The probes on a probe card have to match those pads to make an electrical contact to accurately test each die.

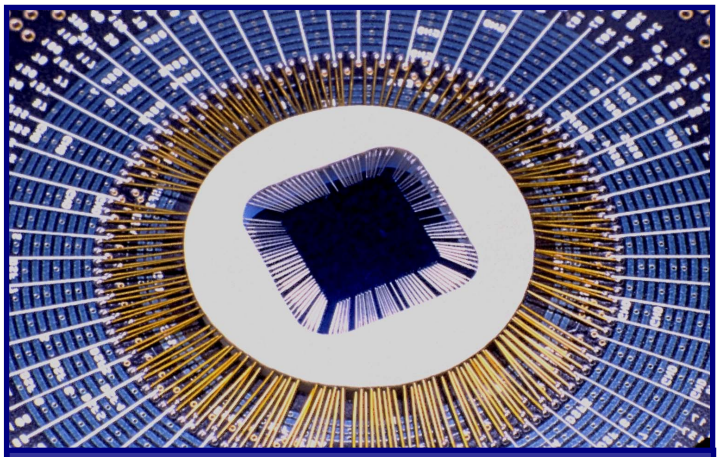

FIGURE 1: Typical example of a probe card test assembly.

During assembly these probes are very carefully put into each ring, and are held in place by epoxy. These assemblies are called "spiders," for obvious reasons. The epoxy can be messy, requiring very delicate and exacting trimming of surplus epoxy from the probes and probe ring (Figure 2).

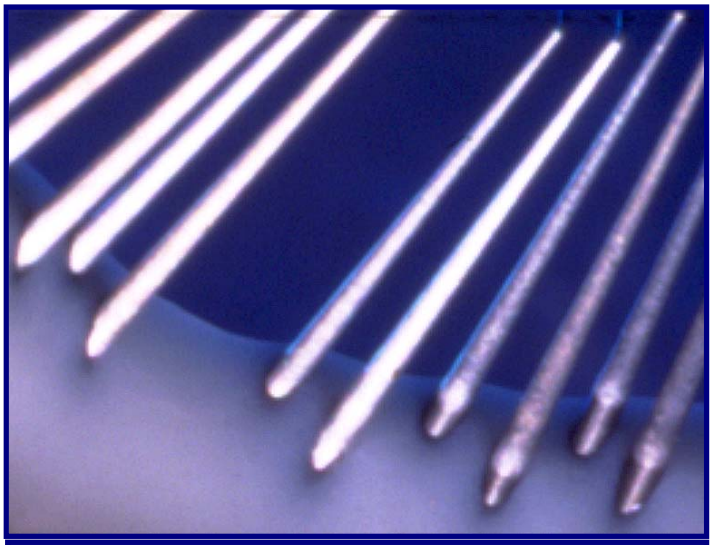

FIGURE 2: The dark areas on the probes on the right hand side are epoxy that must be cleaned away.

One of the things that make this "trimming" a delicate operation is ensuring the required beam length of each probe. Beam length helps control the gram force (how many grams per millimeter of pressure) that is put on each probe.

The probes have to scrub through surface oxidization on the wafer to be able to make electrical contact. If the beam force is too weak, the probe won't get under the oxidation and will show it as an open during testing. If the beam length is too short, it can result in too much gram pressure. This could damage the pad and destroy the ability to bond to the pads. Therefore, a precise gram force is essential, and anything that could compromise this must be carefully considered.

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Commonly, the epoxy trimming process is done using utility knife blades. Operators basically cut the epoxy away by hand. This takes an enormous amount of time and uses a lot of blades, because only the very tip of the blade can be used. Even though these blades are relatively inexpensive, the cost mounts up rapidly when using hundreds of them a day. It can be common to go through 10 to 15 blades on only one ring. The minute the point breaks, the blade is discarded. Another problem arises when using blades on dense cards (cards with many probes). Sometimes tiny sections of the blade tip will snap off and stick in the ring. Often the operator doesn't know this has happened and it can result in a short or in leakage, depending on how close to two probes it is.

The operators who do this trimming are highly trained to be able to accomplish the task without damage to the probes and cards. It takes a great deal of time to do with the precision required, and it still does not remove the material cost for the blades. Training must consist of an exacting step program where the operator starts on low pin (probe) counts–anything from five to fifty. As they become more accomplished, they move up until they can handle higher probe counts.

Today, it is common to encounter probe counts of 600 to 800 or even 1,000 probes on a ring. Probes typically range in size from 0.005 in. to 0.010 in. in diameter. Multi-tier probe assemblies that have tiers of probes on top of each other are also quite common. Because of these highly dense configurations, new methods of handling the trimming process have evolved.

Using Micro-Abrasive Blasting for Trimming

Micro-abrasive blasting has its roots in precision deburring and cleaning of small machine parts and intricate medical/dental instrumentation, but has adapted quite successfully to this application. The technology consists of a WorkStation that encloses an air-pressurized abrasive cleaning unit.

The cleaning unit is comprised of a pencil shaped nozzle attached to a pencil-shaped stylus that is connected to a tube. A precise mixture of an abrasive powder and clean, dry air is carried through this tube to the nozzle. The operator holds the stylus like a pencil and regulates the flow of abrasive with a foot pedal. Using this method, the operator can pinpoint the blast directly at an area to be cleaned without damaging the probes or ring. Because of the small size of the items to be cleaned, a microscope or magnifier is typically attached to the outside of the micro-abrasive work chamber (Figures 3 & 4).

FIGURE 3: A Micro-abrasive WorkStation with microscope for detailed cleaning operations.

Using this technology for probe card trimming requires less operator training and removes the cost of the daily quantity of blades required. The blade cost is replaced by the cost of the abrasive powder needed to conduct this form of trimming, but it still comes in substantially less than the blade cost.

When making a change from other methods to micro-abrasive trimming, dedicated testing should be performed. The type of abrasive powder, nozzle size, and air pressure regulate the cutting characteristics of the process. These variables must be used in different combinations to find the best formula for each individual application. The Comco Engineering Lab has the expertise to assist you with testing and choosing the right mixture necessary to achieve the results you desire.

The hardness of the different epoxies used to hold the probes into the ring will dictate the type of abrasive needed. However, in the majority of probe card trimming applications sodium bicarbonate appears to be the best abrasive. It cleans effectively but is gentle to the fixture and the probes. The best air pressure for these types of applications is usually between 60 and 100 psi.

Micro-Abrasive Blasting Equipment

Effective micro-abrasive blasting requires an enclosed WorkStation to contain the spent abrasive. It must be designed to provide adequate airflow and lighting to give the operator a clean work area with good visibility. The WorkStation is connected to an industrial dust collector capable of evacuating the spent abrasive and storing it for disposal.

Micro-abrasive powders are very sensitive to moisture and oil. To minimize the adverse effects these materials can have on the process it is necessary to use compressed air with less than 200 ppm of moisture (-25ºF dew point) and less than 10 ppm oil. To achieve this, the supply air to the system must be processed through a desiccant or membrane style dryer with proper filtration to remove oil and other contaminants. A refrigerant style dryer cannot provide the level of dryness required for effective micro-abrasive blasting.

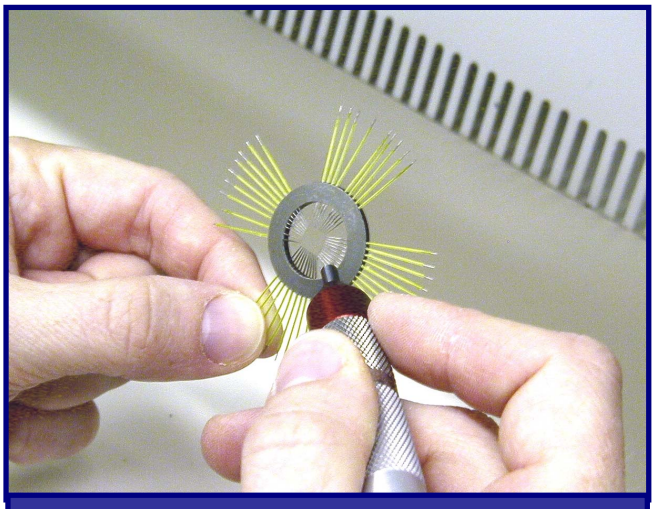
FIGURE 4: WorkStation and single tank MicroBlaster™. Magnifier attached for enhanced viewing during blasting.

The MicroBlaster™ mixes the abrasive media with compressed air and propels it out through the nozzle. The most popular and economical unit is the single tank MicroBlaster™. This blaster and all of Comco's micro-abrasive blasters are equipped with Comco's patented modulator system. The modulator accurately meters the abrasive into the air stream ensuring a steady and consistent flow of abrasive is delivered to the nozzle.

Multiple probe cards with different application requirements can be processed in a single WorkStation by using the dual tank model MicroBlaster™. The dual tank allows the operator to use two different abrasives in the same unit. Separate tanks, mixing chambers, and two independent nozzles allow the operator to switch from one abrasive to the other without fear of cross contamination. This also makes the dual tank an ideal micro-abrasive blaster to use for experimenting with different abrasives on new applications or probes using new types of epoxy.

Probe Card Trimming – Application Overview

In high-volume facilities production blasters like the DirectFlo or the PowerFlo are the preferred choice. These blasters have more power, are capable of utilizing larger hoses, and deliver more abrasive to the nozzle than a standard micro-abrasive blaster. Both of these blasters are equipped with an extra large abrasive tank reducing the time required to refill media. In addition, the PowerFlo is equipped with a microprocessor that captures and exports real time data making it the perfect blaster for integration with automated systems.



Cleaning a spider with the MicroBlaster™.

Nozzle sizes and shapes vary greatly depending on the particular application. A round nozzle delivers a very precise pattern making it possible to direct the abrasive to a confined area. When abrading large areas a rectangular nozzle used like a brush will accomplish the task much faster.

The nozzle opening must be compatible with the size of abrasive being used. Very large abrasive particles will not easily flow through nozzles with small openings. However, when using very small abrasives a smaller nozzle opening allows the operator to direct the abrasive stream with greater accuracy.

There are many types of media used in conjunction with micro-abrasive blasting. The individual size, shape, and hardness of the particles determine the abrasive's cutting characteristics. Sodium bicarbonate particles for example are knife-like or 'needle shaped'. This makes it an effective abrasive for cutting or slicing through the epoxies commonly used in probe card manufacturing.

Comco has an extensive library of technical papers available on issues involving media and powder selection. Consult your Comco representative for additional information.

In Summary

Micro-abrasive blasting is ideally suited for probe card trimming. In some assemblies the probes can be as little as 3 to 4 mils apart from each other. The gaps are extremely small. The MicroBlaster™ has proven to be an effective tool for working within these tight limits. The different hardness of epoxies poses no problem for the process.

When using micro-abrasive blasting to trim probe cards productivity will increase dramatically over manual methods. The reduction in labor time combined with the increased accuracy in probe card assembly trimming will result in the production of high-quality results within fast delivery times.

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