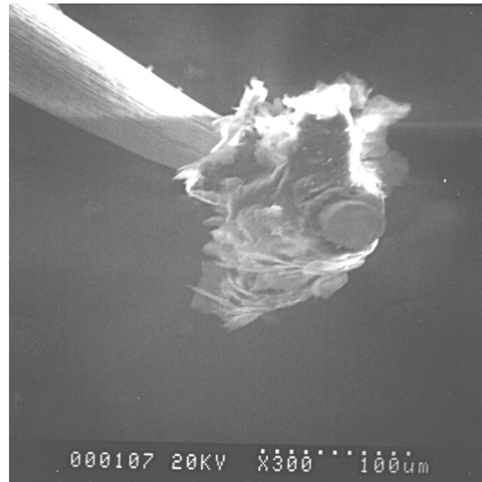
international TEST SOLUTIONS	**Probe Scrub™ HT**	**Technical Brief**

Restore Probe Performance and Remove Bonded Debris

During wafer level test, particulates and other contaminants (e.g., process related organics, bond pad surface oxides, etc.) can accumulate on the contact surface and along the tip length of cantilevered probe tips (as shown in the figure). The rate and extent of contamination accumulation depends on the sort environment cleanliness and the characteristics of the bond pads. The buildup of resistive materials directly affects the contact resistance (C_{RES}) stability and magnitude.



Accumulated debris on the probe tip generated during probing and cleaning.

In all wafer sort operations, low and stable C_{RES} contact resistance is critical for maintaining high wafer yields and avoiding re-probe to confirm the first-pass sort results. To control C_{RES}, on-line abrasive cleaning using alumina (aluminum oxide) lapping film (0.5, 1, 3, or 5-µm grit), a tungsten-carbide plate, or a ceramic block is used to physically remove contaminants from the probe contact surface.

As the probes are repeatedly abraded, the tips are subjected to frictional shear stresses and tip material is removed until the probes are out of specification (tip diameter size and/or planarity and alignment). Abrasive cleaning, albeit effective in removing material from the tip, does not collect debris from the tip length. This debris, as well as the abrasive particles from the cleaning pad, can adhere to the probes or become embedded into the contact surface. A theoretical explanation for these phenomena is given by means of plastic deformation due to the applied load and the Joule heating that causes the particles to “micro-weld” to the probe contact surface.

Probe Scrub™ HT is a multilayered cleaning medium constructed from a highly cross-linked polymer material (**Probe Clean™**) applied over a precision abrasive surface (**Probe Lap™**). **Probe Scrub™ HT** was developed specifically for removing contaminants from cantilevered probes with flat tips and can be used for all types of probe needle materials (i.e., tungsten, rhenium tungsten, beryllium copper, and palladium–alloy). The material provides excellent results during room temperature probing operations as well as under elevated temperature conditions, or “hot chuck”, up to 125°C.

Insertion into **Probe Scrub™ HT** allows for a slight scrubbing action on the abrasive substrate thereby removing embedded and bonded debris from the probe tips. As the probe tip is removed from the material, the polymer layer traps the loose debris. The primary cleaning action of the probe tip contact surface occurs during as the tips scrub across the abrasive material. Additional overtravel (approximately 25 µm) is needed to properly clean the probe tip surface and the cleaning is most effective when probes each insertion occurs at a new location.

Probe Scrub™ can be mounted on various substrates, wafers, and abrasion plates used for on-line and off-line probe cleaning. In the majority of applications, **Probe Scrub™ HT** is used as a direct replacement for on-line lapping film applications. FTIR and XPS elemental detection methods have shown that no residuals are left on the probes or bond pads.

For regular on-line cleaning, the probe tip contact areas are cleaned after ten (10) or less insertions into **Probe Scrub™ HT**; however, certain compounds and accumulated quantities of embedded material may

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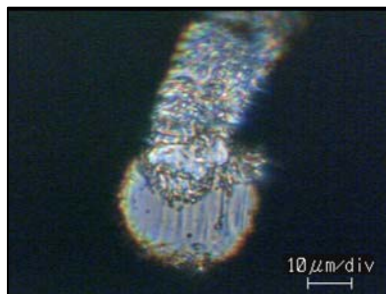
require more and frequent cleaning iterations. Because each specific testing environment will dictate the cleaning frequency required for optimum yield, the exact "recipe" for properly cleaning probe cards must be determined individually for each user.

CASE STUDY – In some wafer environments, oxidized aluminum "tails" are created by the repeated scrubbing action of the flat probe tips against the bond pads. Typically, these "tails" form at the "heel" of the contact surface. As they grow, the "tails" propagate up the tip length (as shown in the first figure below). These "tails" will affect the C_{RES} magnitude of the probe, may cause pin-to-pin shorts, and will eventually fall onto the wafer surface.

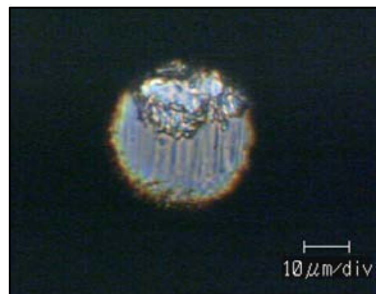
When the test current flow becomes constricted to the increasingly smaller regions intermetallic contact (known as "a-Spots"), localized Joule heating will occur. Due to this heating effect and applied pressure at full overtravel, the aluminum, organic residues, and tip material will interact. As a result, the aluminum attached to the probe surface becomes difficult to remove using non-destructive cleaning methods such as **Probe Clean™**; **Probe Polish™**; or dry brushing with IPA.

The second figure shows the tip probe after 100 insertions into the polymer layer ONLY. The length of "tail" has been removed and collected by the cleaning polymer; however, the aluminum that has bonded to the "heel" of the contact surface remains. The polymer layer of **Probe Scrub™ HT** is specially formulated to encapsulate hazardous particulates and prevent release of these harmful materials into the clean room environment. After the material has been used to clean and collect potentially hazardous materials from the probe, it must be properly disposed in appropriate waste containers according to OSHA recommended practices.

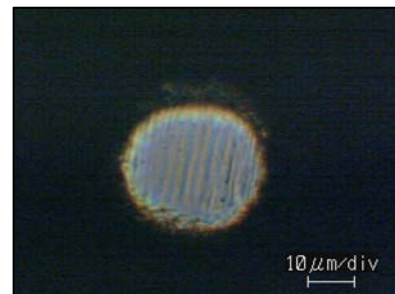
The non-alumina abrasive surface under the polymer layer is effective for removing the adherent from the probe contact surface. After ten (10) insertions, the bonded contaminants have been removed from the probe contact surface (as shown in third figure below) and the probe card is ready for use.



Aluminum "tail" at the heel of the contact surface.



"Tail" was removed with Probe Clean™ but surface is not clean.



Bonded material removed from tip surface with Probe Scrub™.

International Test Solutions recommends that the material is used regularly to remove debris and clean the probe contact surface. Probe card cleaning frequency varies according to the specific testing environment and some users have reported cleaning as frequently as every 50 die touchdowns while others clean periodically at 4000 die touchdowns.

Contact **International Test Solutions (ITS)** directly or a local **ITS** distributor with your specific probe card cleaning requirements.

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