Acceptable outer edge sweep limits for 3M™ Trizact™ Pad Conditioners

Bringing together 3M’s know-how in abrasives, ceramics and microreplication, the 3M™ Trizact™ Pad Conditioner is an innovative pad conditioner for chemical mechanical polishing (CMP) for advanced node semiconductor manufacturing.

The Trizact pad conditioner uses precisely engineered three-dimensional micro-replicated ceramic structures coated with chemical vapor deposition (CVD) diamond. These structures are located on the surface of each “element” mounted on the pad conditioner substrate. A pad conditioner may have five or more elements mounted on the substrate.

During use, all pad conditioner elements must remain in contact with the pad surface at all times. To ensure all elements remain in contact with the pad surface, please review this paper and the acceptable Outer Edge Sweep Limits defined in Table 1.

**Configure your CMP tool**

The Trizact pad conditioner working surface is comprised of five or more elements which must remain in contact with the pad. When configuring your CMP tool pad conditioner sweep profile, ensure the sweep limits are established to prevent the conditioner from traveling beyond the pad edge.

For some CMP tools, the diameter of the pad may exceed the platen diameter, causing the pad to overhang the platen unsupported. For this scenario, ensure the pad conditioner sweep does not exceed the pad diameter, as illustrated in **Figure 1**.
Avoid pad edge damage

If the 3M™ Trizact™ Pad Conditioner is allowed to sweep beyond the pad edge of an unsupported pad (Figure 2), the result may include damage to the pad, pad conditioner, or the platen. Such damage is illustrated by using a soft, suede type pad, whereby the pad conditioner sweep was allowed to exceed the pad diameter, see Photo A.

Using the same tool sweep recipe with an industry standard hard pad constructed with a stiff subpad (Photo B), there may be no visible damage to the pad edge upon inspection.

However, the sweeping action across the edge of a hard pad has potential to increase the stress on the Trizact working tips and potentially damage the conditioner.

Sweeping beyond the pad diameter of an unsupported pad may have consequences of higher pad wear along the pad edge. The Trizact pad conditioner is constructed with five or more discrete elements that distribute the applied downforce to the pad (Figure 2). If elements travel beyond the pad edge, the downforce is increased for the elements remaining on the pad. This scenario creates greater depth of penetration and friction near the pad edge and increases the amount of pad wear at the pad edge.

Another concern is that as the conditioner spins at the edge of the pad the elements leaving and returning to the pad could cause an oscillation at the location downforce is applied, Figure 3. In turn, the oscillation could cause rocking and gouging of the pad edge. Ultimately, this could cause increased stress on the Trizact pad conditioner working tips, increase the potential for vibration and potentially damage the conditioner.
Acceptable outer edge sweep limits for 3M™ Trizact™ Pad Conditioners

Optimizing the sweep settings
Adjustments to the sweep settings may be required for your CMP tool if the current recipe allows the pad conditioner to sweep beyond the pad diameter.

As an example, a customer replaced their traditional diamond grit conditioner with the 3M™ Trizact™ Pad Conditioner and obtained the pad profile of Figure 4. The tool recipe allowed the conditioner to sweep beyond the pad edge.

By implementing an “outer edge sweep limit” and optimizing the dwell times, the pad profile was dramatically improved, Figure 5. The improved pad profile also improved the wafer edge non-uniformity results throughout the pad life.

Recommendations for Sweep Settings
In light of the information above, 3M recommends the conditioner should only sweep so far as the pad conditioner center-of-mass is always supported by the underlying platen and that no element should travel completely off of the pad. Typical limits to be observed for both AMAT and Ebara CMP tools are listed below.

Table 1.

<table>
<thead>
<tr>
<th>CMP Equipment</th>
<th>Platen Size</th>
<th>Outer Edge Sweep Limit*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Materials (300mm)</td>
<td>30 inches / 760 mm platen</td>
<td>13.50 inches / 343 mm</td>
</tr>
<tr>
<td>Applied Materials (200mm)</td>
<td>20 inches / 508 mm platen</td>
<td>8.25 inches / 210 mm</td>
</tr>
<tr>
<td>Ebara (300mm)</td>
<td>29 inches / 740 mm platen</td>
<td>12.75 inches / 324 mm</td>
</tr>
</tbody>
</table>

*The “outer edge sweep limit” locations is defined as the distance from the center of the pad to the center of the pad conditioner. These limits apply to all 5, 7, and 10 element conditioners regardless of the carrier they are mounted on (4.00” or 4.25”).

Make sure to avoid collision between the conditioner and the wafer head when in-situ conditioning by synchronizing the conditioner and wafer head sweeps appropriately.

Note: Consult the operating guide for your CMP tool before implementing changes to the sweep.
Acceptable outer edge sweep limits for 3M™ Trizact™ Pad Conditioners

<table>
<thead>
<tr>
<th>Recommended</th>
<th>Not Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Figure 6a" /></td>
<td><img src="image" alt="Figure 6d" /></td>
</tr>
<tr>
<td><img src="image" alt="Figure 6b" /></td>
<td><img src="image" alt="Figure 6e" /></td>
</tr>
<tr>
<td><img src="image" alt="Figure 6c" /></td>
<td><img src="image" alt="Figure 6f" /></td>
</tr>
</tbody>
</table>

Figure 6: Summary of pad sweep scenarios.

Regulatory: For regulatory information about this product, contact your 3M representative.

Technical Information: The technical information, recommendations and other statements contained in this document are based upon tests or experience that 3M believes are reliable, but the accuracy or completeness of such information is not guaranteed.

Product Use: Many factors beyond 3M’s control and uniquely within user’s knowledge and control can affect the use and performance of a 3M product in a particular application. Given the variety of factors that can affect the use and performance of a 3M product, user is solely responsible for evaluating the 3M product and determining whether it is fit for a particular purpose and suitable for user’s method of application.

Warranty, Limited Remedy, and Disclaimer: Unless an additional warranty is specifically stated on the applicable 3M product packaging or product literature, 3M warrants that each 3M product meets the applicable 3M product specification at the time 3M ships the product. 3M MAKES NO OTHER WARRANTIES OR CONDITIONS, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OR CONDITION OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY IMPLIED WARRANTY OR CONDITION ARISING OUT OF A COURSE OF DEALING, CUSTOM OR USAGE OF TRADE. If the 3M product does not conform to this warranty, then the sole and exclusive remedy is, at 3M’s option, replacement of the 3M product or refund of the purchase price.

Limitation of Liability: Except where prohibited by law, 3M will not be liable for any loss or damage arising from the 3M product, whether direct, indirect, special, incidental or consequential, regardless of the legal theory asserted, including warranty, contract, negligence or strict liability.

3M

Electronics Materials Solutions Division
3M Center, Building 224-3N-11
St. Paul, MN 55144-1000
1-800-251-8634 phone
651-778-4244 fax
www.3M.com/electronics

3M and Trizact are trademarks of 3M Company.
Please recycle.
©3M 2015. All rights reserved.
60-5002-0821-4

(4)