Selected Area Preparation

Solutions for Decapsulation, Substrate Thinning and Polishing

We stock a wide range of tools and consumables!

www.ultratecusa.com
Supporting the FA & microscopy community by continually improving sample preparation methods & results.

Since product launch, ASAP-1 has become the standard piece of equipment that engineers involved in failure analysis, yield enhancement and competitive analysis, use for backside preparation of packaged semiconductor and related devices.

In recent years, driven by exponential growth of newer packaging types; CSP, MCM, BGA, flip-chip, to name a few; in addition to ever more demanding analytical methods, ASAP-1’s application array has been expanded to enable mechanical decapsulation and topside de-processing.

The latest ASAP-1 models provide the same intelligent engineering approach and intuitive user interface, whilst incorporating advanced optical sample alignment and high torque motor options to handle the most ‘difficult’ i.e. sample preparations. Aesthetics and system access have also been improved to enhance the ease of use.

All our products are backed by ULTRA TEC’s comprehensive before and after-sales support, which includes in-house applications, design, custom manufacturing and sales engineering. We are represented throughout the world by a team of dedicated sales partners. Our products are used by many domestic and international service labs.

We look forward to continuing to work with you!

OPTICAL ALIGNMENT

- Enabling layer by layer removal
- Improving planarity for topside & backside applications

Our patented ULTRACOLLIMATOR technology allows for fast, accurate and repeatable parallel alignment of the surfaces to the preparation system. Since the ULTRACOLLIMATOR beam aligns directly to the die, there is no guesswork or the need to use mechanical indicators. Transfer to-and-from the microscope is made fast and accurate. Any small realignments can be made quickly and accurately.
ACCURATE, INTUITIVE SAMPLE POSITIONING

• Fast amplitude setting
• Tilt Table accommodates in-package die tilt
• New X-Y Micro-adjust stage provides ‘on the fly’ sweep-center modification

ASAP-1 incorporates controls to achieve the alignment and processing of all sizes of sample – from sub-mm die / FIB trenches up to large flip-chip CPU modules. The system provides X-Y amplitude control – providing up to a standard 1 inch (25.4mm) maximum cavity size, or an optional 2 inch (50mm) amplitude upgrade, for large dice and cavities.

The X-Y Independent table drive is now fitted as standard, allowing for single axis trenching and improved angular alignment. ASAP-1’s tilt table is maintained, allowing for ‘in package’ die tilt to be accommodated, along with the ability to translate the ULTRACOLLIMATOR signal into fast, accurate sample alignment.

Recent upgrades to the tool drive include the option for a 3X torque motor, providing the power required to optimize heavy milling and material removal.

ADVANCED, IMPROVED SYSTEM CONTROLS

• All motor program controls are positioned on the front panel
• In-built LCD Monitor
• MACRO-VISION Camera mode for process monitoring

The latest ASAP-1 models incorporate upgraded controls, including process timer and improved traveling table and motor control. Independent Table Drive switching, the optional LCD monitor / ULTRACOLLIMATOR are all controlled from the front panel of the unit. The LCD monitor is easily switched between ULTRACOLLIMATOR and MACRO-VISION modes.

The MACRO-VISION Camera provides important real-time feedback to the operator, with a magnified view of the sample surface being de-processed, polished or decapsulated.
If your package or sample type is not listed here, please contact us to see how we can help.
Mech-Chem Decapsulation

Mechanical decapsulation offers key advantages for topside sample preparation. As well as for avoiding bond wires to optimize the survivability of chemical-etch and dry-decap (RIE or plasma) systems, the method may also be used to open up areas large enough to allow for high-power lenses to be positioned within their depth of focus, or for SIL applications.

**BETORE**

Package after 120 seconds Mechanical Decap 1 step diamond tool process. Process Endpoint is approx. 15 microns above front-side circuitry.

**AFTER**

Packaged Part after an additional 8 second chemical Decapsulation process.

Mech-Chem Decapsulation offers key advantages for topside sample preparation. As well as for avoiding bond wires to optimize the survivability of chemical-etch and dry-decap (RIE or plasma) systems, the method may also be used to open up areas large enough to allow for high-power lenses to be positioned within their depth of focus, or for SIL applications.

**Mech-Chem Decapsulation**

Mechanical decapsulation offers key advantages for topside sample preparation. As well as for avoiding bond wires to optimize the survivability of chemical-etch and dry-decap (RIE or plasma) systems, the method may also be used to open up areas large enough to allow for high-power lenses to be positioned within their depth of focus, or for SIL applications.

**Tunnel Decapsulation**

Typical mechanical decap operations require 1 or 2 process steps, dependent on required surface finish. A simple change of X and Y amplitude after the first process reaches the bond loop height allows for a ‘stair step’ avoidance of the bond wires. Total Process time can be as low as 100 to 200 seconds.

ASAP-1’s accurate Z-position control allows for the process end-point to be achieved within an epoxy layer (often as little as 10 to 20 microns thick) directly above the die’s topside. A subsequent short chemical etch, or dry decap process yields a sample ready for topside analysis.

Point Decapsulation

Point Decapsulation allows for Circuit edit to be made in the de-capsulated area, whilst the bulk of the device remains under the encapsulant, thus retaining all its RF & dielectric properties.

The left image shows a macro-view of a sub-mm wide area of area of a device decapsulated with ASAP-1. Focus on the circuitry and package surface simultaneously is not possible due to the (> 1 mm thick) thickness of encapsulant.

The right image shows a close-up of the decapsulated area.

Decapsulation of Stacked Die Packages

Multi-chip CSP’s provide an unique challenge to the failure analyst in that standard chemical decapsulation methods are not applicable, particularly if the package contains two or more stacked dice. ASAP-1 machinery allows for rapid and effective CSP decapsulation with resulting ‘live’ circuitry ready for testing and failure analysis.

Application information courtesy of FIBICS Inc., Ottawa, Canada (http://www.fibics.com).
Focus on Applications

Backside

Focus on Applications

Graph Showing Optimum Silicon Thinning Range for Backside Analysis

Selected Area Preparation of Wafers

Backside preparation of a single die on a full wafer can be required for yield enhancement or failure analysis purposes. To make this possible, a wafer stage is available for ASAP-1. The standard tilt table is removed to allow for the wafer stage.

Preparation is generally a four step process (1 substrate thinning and 3 polishing steps). This yields an optimized polished surface ready for backside imaging.

Frontside probing on a standard or inverted probe station can be used to bias the wafer for backside analysis, but the thinned wafer must be made strong enough to withstand the pressures exerted by probe tips, while still being optically transparent for backside analysis.

ULTRA TEC has developed a special technique for re-strengthening wafers using a UV curing optical epoxy and glass cover slip. A typical re-strengthened wafer cavity is shown in the photograph to the right.

Producing Thin-Parallel Samples

Full die thinned, polished and cross sectioned at 22 µm of remaining Silicon. Advanced controls on ASAP-1 accommodate for package die tilt and allow for the preparation of extremely thin and parallel substrates.

NOTE: Less than 1 um thickness variance across die.
Mechanical polishing allows for a failure site to be precisely located with the layers of circuitry. However, personnel with the necessary skills are at a premium for this application, not least due to the manual dexterity required to get reproducible results.

ASAP-1 produces immediate increases in both alignment accuracy – leading to improved polishing flatness – and process convenience – allowing for better reproducibility and operator-to-operator consistency. This offers the potential to ‘de-skill’ the de-processing operation.

Other significant benefits for the engineer include ...

1) Polishing times are kept short due to the small area in contact with the polishing tool.
2) The Sample is easily transferred to and from the microscope, ULTRACOLLIMATOR allows for fast ‘on the fly’ alignments.
3) The ‘footprint’ for sample preparation equipment can be kept small. ASAP-1 can be used to multi-task topside, backside and decapsulation usage.

Examples of Topside De-processing
Results with ASAP-1

The images above show the results of 3 samples de-processed with ASAP-1, taken with 20X Objective. BEFORE Images show the die before any polishing has taken place. AFTER images show the same area of the die, de-processed to M1/poly silicon level.

Sequential Layer De-processing
Sequentially de-processed 0.18 micron technology device. Images courtesy of Christophe Guerin, CELAR, France.

Topside Selected Area De-processing
‘In Package’
PRE-FIB. BACKSIDE THINNING

Use of a sub-mm set of ASAP tools, allows for very small FIB-trenches and corner areas to be revealed for backside identification (fiducial marks etc) and for BACKSIDE FIB-edits, or related applications. Mechanical thinning on ASAP-1 is rapid and temperature is kept cool due to the patented floating-head motion employed on the system. Polishing is easy to accomplish with similar diameter Xylem tools.

IMAGE shows Precision decapsulated PCB. Image courtesy of Skyworks Solutions, Inc.


SAMPLE PREPARATION FOR WIRE-TO-WIRE REBONDING

Rapid mechanical decapsulation and preparation allows for subsequent re-bonding or repackaging of devices for both the topside and backside, where such techniques are required. The use of ULTRACOLLIMATOR allows for fast, accurate alignment from the ‘underside’ of the device being processed.


CUSTOM GASKET MANUFACTURING

The ASAP-1 can be used to manufacture custom gaskets for all major chemical decapsulators. Both simple and more complex shapes can be made ‘in house’ with the high precision specifications of ASAP-1 table drive. Results are accomplished the need for the engineer to send time-critical or information-sensitive parts to a third party. An intuitive one or two-step process provides the necessary required surface finish on the elastomer.

Custom-made gaskets for acid decapsulators.
ARC-lite offers fast (less than 1 minute), reliable, room temperature AR coatings on package and wafer level devices. The samples produced are NIR optimized and require no subsequent baking.

ARC-lite reaches maximum functionality when used with the ASAP-1 System or our ULTRAPOL Advance flat lapping machine, which both produce optimized backside-thinned and polished samples, ready for AR coating.

ARC-lite improves Images at all observation wavelengths from 950nm to 1400nm and beyond. This makes coatings effective for ALL backside microscopy techniques, including photon emission microscopy, laser-scan, thermal and voltage alteration scans, SIFT, FIB etc. The system can also double as a spin-coater for FMI coatings and one-off photo-resist layers.

Product Highlights
- Fast and convenient – typically 45 second process
- Up to 30% more transmitted photon efficiency
- Up to 60% improved contrast under NIR
- Bench-top, quiet, room temp. process
- All package types and sizes
- ARC can be done in-house – NO baking
- Optimizes emission microscopy, laser, FIB, voltage, thermal and other backside techniques

Before ARC

After ARC

Imaged with OptoMetrix LSM

Imaged with FA Instruments system

Imaged with ARC/Micromanipulator system

Imaged with Hypervision (V2)/Credence (Meriden) system

Imaged with Credence (OPTIFIB) system

Imaged with Semicaps system

Imaged with QFI system

Imaged with TnP/KORIMA system

Imaged with FEI system

Application of FIB-friendly AR imaging fluid to a packaged part.

Point of application filtration of standard AR imaging fluid.
SAP Consumables

ASAP TOOLS: Standard Sizes

<table>
<thead>
<tr>
<th>Step</th>
<th>Part #</th>
<th>Application</th>
<th>Tool Type</th>
<th>Lubricant Used</th>
<th>Approx. Tool Lifespan (# Parts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5210. D</td>
<td>Removing Package Materials</td>
<td>Coarse Diamond</td>
<td>Water or Extender</td>
<td>30</td>
</tr>
<tr>
<td>2</td>
<td>5215. D</td>
<td>Copper Paddle Removal</td>
<td>Milling Tool</td>
<td>Extender</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>5260. D</td>
<td>Substrate Thinning</td>
<td>Fine Diamond</td>
<td>Water or Extender</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>5295. D</td>
<td>Initial Polish</td>
<td>XYLEM</td>
<td>Extender + Diamond Paste</td>
<td>30</td>
</tr>
<tr>
<td>5</td>
<td>5295. D</td>
<td>Medium Polish</td>
<td>XYLEM</td>
<td>Extender + Diamond Paste</td>
<td>30</td>
</tr>
<tr>
<td>6</td>
<td>5299. D</td>
<td>Final Polish</td>
<td>XYBOVE</td>
<td>Colloidal Silica</td>
<td>6</td>
</tr>
</tbody>
</table>

ASAP TOOLS: SCOPE OF USE

<table>
<thead>
<tr>
<th>Tool Diameter (= D)</th>
<th>Cavity / Die Size Range (X or Y diameter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 mm</td>
<td>2 mm to 5 mm</td>
</tr>
<tr>
<td>2 mm</td>
<td>5 mm to 9 mm</td>
</tr>
<tr>
<td>3 mm</td>
<td>9 mm to 15 mm</td>
</tr>
<tr>
<td>5 mm</td>
<td>15 mm upwards</td>
</tr>
</tbody>
</table>

Notes

* The "D" in the ASAP-1 Tool part numbers refers to the diameter of the polishing tool. – See "Tools: Scope of Use" chart.
  – When ordering, replace the "D" with the required diameter.

* Approx. # cycles/tool have been determined empirically. Actual longevity of each tool depends on many factors and will vary.

ADDITONAL ASAP TOOLS – Standard Sizes

<table>
<thead>
<tr>
<th>Part #</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>5200. D</td>
<td>Boxed Consumable Set - 1 off each standard ASAP tool (Steps 1 to 6) plus 1 off 5298.D tips – single diameter XYBOVE replacement tips for final polish (Set of 6)</td>
</tr>
<tr>
<td>5298. D</td>
<td>Extra coarse diamond tool, for faster removal of ceramics &amp; tough materials</td>
</tr>
<tr>
<td>5208. D</td>
<td>Intermediate Diamond tool – suits Stack die decap and low toughness package materials</td>
</tr>
</tbody>
</table>
Sub-mm ASAP TOOLS

<table>
<thead>
<tr>
<th>Step</th>
<th>0.7mm Ø Part #</th>
<th>0.7mm Ø Part #</th>
<th>Tool type</th>
<th>Lubricant Used</th>
<th>Approx. Tool Lifespan (# Parts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5210. 07</td>
<td>5210. 04</td>
<td>Coarse Diamond</td>
<td>Water or Extender</td>
<td>5 - 10</td>
</tr>
<tr>
<td>2</td>
<td>5215. 07</td>
<td>5215. 04</td>
<td>Milling Tool</td>
<td>Extender</td>
<td>5 - 10</td>
</tr>
<tr>
<td>3</td>
<td>5260. 07</td>
<td>5260. 04</td>
<td>Fine Diamond</td>
<td>Water or Extender</td>
<td>5 - 10</td>
</tr>
<tr>
<td>4-6</td>
<td>5295. 07</td>
<td>5295. 04</td>
<td>XYLEM - Note: use for all 3 polishing steps</td>
<td>Extender + diamond Paste or colloidal silica</td>
<td>5 - 10</td>
</tr>
</tbody>
</table>

ASAP – OTHER CONSUMABLES

<table>
<thead>
<tr>
<th>Part #</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>2394.4</td>
<td>Colloidal Silica (4oz bottle)</td>
</tr>
<tr>
<td>2396.4</td>
<td>Extender Fluid – mineral oil-based (4oz bottle)</td>
</tr>
<tr>
<td>2382.5</td>
<td>Step 4 Blue Diamond Paste, (5 gram tube)</td>
</tr>
<tr>
<td>2385.5</td>
<td>Step 5 Yellow Diamond Paste, (5 gram tube)</td>
</tr>
<tr>
<td>2387.1</td>
<td>Crystal Wax – low temperature adhesive (70ml stick)</td>
</tr>
<tr>
<td>2304.1</td>
<td>Loctite ‘404’ epoxy, 0.3 oz bottle – for use with the Xybove Re-application tool</td>
</tr>
<tr>
<td>2306.1</td>
<td>Loctite ‘460’ epoxy, 0.7 oz bottle – epoxy for holding samples for SEM/TEM sample preparation</td>
</tr>
<tr>
<td>2308.1</td>
<td>UV Curing epoxy – for Wafer cavity refilling</td>
</tr>
<tr>
<td>5203.1</td>
<td>Spare Centering Tool – stainless steel</td>
</tr>
</tbody>
</table>

ARC-lite CONSUMABLES

<table>
<thead>
<tr>
<th>Part #</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>6341.4</td>
<td>ARC-lite Standard Imaging Fluid, 4 oz. Applicator bottle (Red)</td>
</tr>
<tr>
<td>6344.8</td>
<td>ARC-lite Solvent, 8oz. Applicator bottle (Yellow)</td>
</tr>
<tr>
<td>6343.4</td>
<td>FIB-Friendly Imaging Fluid, 4 oz. Applicator bottle (Green)</td>
</tr>
<tr>
<td>6326.1</td>
<td>Point of Application Filter Kit - includes 2 x syringe and 10 x filter</td>
</tr>
</tbody>
</table>

Primary Observation Wavelength | Surface Hue (after coating) |
--------------------------------|----------------------------|
980 nm and below | Blue                      |
1064 nm          | Blue / Yellow             |
1200 nm and above | Gold / Purple             |
ORDER CODE

ASAP-1 with optical control 6360.1S
ASAP-1 6360.2S
ARC-lite 6340.1

DESCRIPTION
Selected Area Preparation System, 100-240V, 50/60Hz. Includes: Motorized X-Y table, tool spindle drive with 1 micron Z-resolution, compound sine tilt-table, timer, independent X-Y table drive, ULTRACOLLIMATOR optical alignment capability, machine vision module, 6.5 inch lcd monitor, sample set-up and loading kit and set of 2mm diameter tools.

Selected Area Preparation System, 100-240V, 50/60Hz. Includes: Motorized X-Y table, tool spindle drive with 1 micron Z-resolution, compound sine tilt-table, timer, independent X-Y table drive, sample set-up and loading kit and set of 2mm tools.

Anti-reflective Coating System, 100-240V, 50/60Hz, with timer, sample holder, 4 oz bottle of Standard Imaging fluid, and 8 oz bottle of Solvent.

SYSTEM DIMENSIONS (WxDxH)
ASAP-1 6360.1S 15.5"(39cm) x 22"(56cm) x 23"(58cm)
ASAP-1 6360.2S 15.5"(39cm) x 22"(56cm) x 23"(58cm)
ARC-lite 6340.1 11.5"(29cm) x 13"(33cm) x 11.5"(29cm)

SYSTEM WEIGHT
ASAP-1 6360.1S 130lbs (59Kg)
ASAP-1 6360.2S 125lbs (57Kg)
ARC-lite 6340.1 40lbs (18Kg)

ASAP-1 SYSTEM UPGRADES
6715.1 High Torque Motor
3X Torque motor. Suits aggressive material requirements such as removal of thick heat-sinks, removal of metals.

6720.1 Large X-Y Amplitude
Upgrade to 2 inch (50mm) maximum amplitude for traveling table. Suits large die sizes, boards and modules.

KEY ACCESSORIES
6338.5 X-Y Microadjust Stage
Enables fine adjustment of the sweep center. Suits small dice and cavities, multi-chip modules

6373.1 Wax-in Sample Holder
Allows encapsulation of odd-shaped samples, dead-bug packages etc. Used with paraffin wax or Crystal wax.

6372.1 Xybove Re-application Tool
Re-mounting station for Xybove final polishing tips. Supplied with 3 sheets of Xybove and tools for manufacture of 1mm, 2mm, 3mm and 5mm Xybove tips

6388.1 Flip-over Sample Holder
Allows for ULTRACOLLIMATOR alignment of packages and samples that have no access for ‘opposite-side’ alignment.

6361.8 Wafer holder (200mm)
Holds entire 200mm wafer for alignment on ASAP-1. Note: 300mm solutions are also available

1301.A Lamp
For illumination of work-area

As represented in your area by:

ULTRA TEC is proud to operate a continuous product improvement program. Product specifications and appearance are subject to modifications without prior notification.

Toll Free (US) 1-877-542-0609
Tel: 1-714-542-0608  Fax: 1-714-542-0627
1025 E. Chestnut Ave.
Santa Ana, CA 92701-6425, USA
Email: info@ultratecusa.com
www.ultratecusa.com