Zyvex E-Beam Current Analysis Package

Probe-assisted SEM characterization

Overview

This package is the complete solution for Electron Beam Induced Current (EBIC) and Electron Beam Absorbed Current (EBAC) characterization. A host of failures in today’s devices can be attributed to mismatched doping concentrations, misplaced dopants, opens, and shorts. These failure mechanisms can be located and characterized using the E-Beam Current (EBC) Analysis Package. The package consists of a two stage ultra high gain amplification system, an E-Beam scan control system, cables, interface hardware (for your specific SEM), and a software interface to control it all.

The included E-Beam scan control system allows for ultimate flexibility in digital E-Beam control. A dual input feature allows the EBIC/EBAC signal and another imaging signal, such as a secondary electron detector, to be acquired and displayed simultaneously. The user is able to collect ultra-high resolution images through the scan control system for further image processing.

Both a real time and post processing digital zoom function allows increased magnification without altering SEM magnification. Post acquisition line profiles can be extracted from maps for advanced analysis with a choice of multiple autoscaling routines, a histogram tool, and user defined or predefined intensity look-up tables. Post image processing capability also includes false colorization and image overlay, as well as a wide range of mathematical functions which can be applied to the images and data set.

EBIC Characterization

The EBIC technique uses the E-beam to induce a charge into a PN junction. A pre-amplifier is connected to the sample stage or a probe tip and an image is gathered through this channel as the E-beam rasteres across the sample. The resulting image is then mixed with the secondary electron detector image and yields varying contrast between the P and N regions. The dopant concentration and any irregularities are now characterized.

EBAC Characterization

The EBAC technique is similar to EBIC, but is used on metal lines and buried vias. During EBAC characterization, the metal line absorbs current from the E-beam. A probe is connected to the line and again routes through a pre-amplifier to capture an image as the E-beam rasteres across the sample. This can be done on a metal line on the surface and it will yield a quantitative active voltage contrast image. The technique is more powerful than traditional AVC, since it allows you to locate and characterize buried faults up to four layers down. A line can be contacted at metal layer 4 and an image can be captured of that same line at layer 3 and 2. The EBC Package is highly sensitive and can detect small currents from the metal line through the dielectric. By increasing the beam voltage, a user can image deeper into the sample. Shorts and opens are located before destructive deprocessing eliminates the ability to detect them.
The EBC Package uses powerful software to process the images during and after acquisition. Each image can be mixed, colored, and binned to reveal fault locations.

### Zyvex EBC Technical Specifications

#### Components and Control
- Standard Low Noise Package (sold separately)
- PC-based software installed on Zyvex PC
- 2-Stage Amplifier
- Scan Controller
- Interface cabling available for SEMs

#### Electronics Capabilities

<table>
<thead>
<tr>
<th></th>
<th>EBIC</th>
<th>EBAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transimpedance</td>
<td>$10^7 - 10^9$</td>
<td>$10^7 - 10^9$</td>
</tr>
<tr>
<td>Bandwidth [kHz]</td>
<td>200 - 500</td>
<td>1.2 - 50</td>
</tr>
<tr>
<td>Resolution</td>
<td>Better than 51A</td>
<td>Better than 51A</td>
</tr>
<tr>
<td>Accuracy</td>
<td>Better than 200 fA</td>
<td>Better than 200 fA</td>
</tr>
<tr>
<td>Bias Voltage</td>
<td>+/- 10V</td>
<td>+/- 10V</td>
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</table>

#### Imaging Capabilities

<table>
<thead>
<tr>
<th></th>
<th>EBIC</th>
<th>EBAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>Better than 10nm</td>
<td>Better than 5nm</td>
</tr>
<tr>
<td>Acq time</td>
<td>Reaction - 60s</td>
<td>30s - 540s</td>
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<tr>
<td>Pixel Resolution</td>
<td>8000 pixels per line</td>
<td>8000 pixels per line</td>
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<tr>
<td>Pixel dwell time</td>
<td>400ns - 400msec</td>
<td>400ns - 400msec</td>
</tr>
<tr>
<td>Bytes/pixel</td>
<td>1, 2, 4 (user selectable)</td>
<td>1, 2, 4 (user selectable)</td>
</tr>
</tbody>
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### EBIC

**Electron Beam Induced Current**

The probe is used as a current imaging device through a medium gain amplifier.

- Higher bandwidth for faster imaging rates.
- Used to characterize PN junctions and their dopant quality.
- Can be used for planar EBIC or cross-sectional EBIC.

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### EBAC

**Electron Beam Absorbed Current**

The probe is used as a current imaging device through a high gain amplifier.

- The user is looking for breaks in metal lines that may be buried up to 3 or 4 layers deep.
- A quantitative form of active voltage contrast.
- Can achieve femto-level sensitivity.

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