Backside Emission Microscopy

Application Note

Introduction

As the number of metallization layers increases, it becomes more difficult to view photon emissions generated by defects in the lower layers from the top side of the semiconductor device. To view emissions on lower layers, one must view the device from the backside. The FA-2000™ offers a one-camera solution for both front and backside emission microscopy, package or wafer level.

To view emissions from the backside, the silicon substrate must be made accessible, thinned and polished. Several preparation methods have been successfully used by the semiconductor industry. The device is illuminated with an NIR (Near Infrared) light source. The NIR wavelengths pass through the thinned silicon and reflect back from the metal layers, creating an image of the traces through the optics on the CCD sensor. Similarly, when the device is powered and is emitting, the emissions NIR component can pass through the thinned polished silicon for emission detection.

Detector

CCD cameras have a typical silicon spectral response of 400nm to 1050nm. A CCD camera with a high *signal to noise* ratio can detect a few photons in the 1200nm range. Given this limitation of a silicon detector's sensitivity in the NIR, the spectral response of CCDs is still sufficient to allow imaging and emission detection from the backside. For optimum CCD sensitivity, Micromanipulator uses proprietary technology to increase the *signal to noise* ratio.

NIR Illumination

To image the device through the thinned polished silicon, one must use an NIR light source. The quality of the image will depend on the light source and the thickness, polish and dopant characteristics of the silicon. Highly doped silicon will absorb more NIR light. Micromanipulator's NIR illumination is currently providing backside photoemission images of highly doped microprocessor devices for our customers.

NIR Optics

The FA-2000™ uses long working distance NIR objectives, which are rated for 400nm-1800nm.

Backside Preparation

Backside emission microscopy sample preparation uses the same technologies of lapping and polishing that have been used for NIR imaging for the past 10-15 years.

Package Level

For package level devices, the back of the ceramic or plastic package is removed to expose the silicon, which is then thinned and polished for imaging.

Wafer Level

Typically, the die are cut from the wafer and then lapped or polished. The full wafer may be polished however, this makes the wafer fragile and difficult to handle without a support device such as Micromanipulator's wafer carrier. Single die milling on the wafer is also used in some instances, typically for work on backside analytical probe stations.

Choices of lapping, polishing and other backside preparation methods should be made based on device, time and cost requirements. The FA-2000™ successfully imaged some devices unpolished and unthinned. Often, imaging is possible through hundreds of microns of silicon. Heavily doped substrates require the most extensive backside preparation. Please call to discuss your requirements, send us a sample, or have us bring the FA-2000™ to your site for a demonstration.

Vibration Coupling and Backside Imaging

When imaging on a test head, vibration coupling is used to capture clear images even at high magnification. The same patented vibration coupling which is widely used with the FA-2000™ on test floors for frontside emission imaging is modified for backside emission imaging vibration coupling on test heads. The FA-2000™ is a one-camera solution for frontside and backside emission imaging, package or wafer level, probe station or test head.

FAQ

"How thin does the silicon need to be for backside emission imaging?"

The required thickness would depend on the dopant characteristic of the silicon. Heavily doped silicon will absorb more NIR and will need to be thinned more, perhaps to 100 micron or less. On the other hand, lightly doped silicon can be as thick as the polished wafer. Typical thicknesses can range from 50 microns to 500 microns.

1555 Forrest Way
Carson City, NV 89706
info@micromanipulator.com
www.micromanipulator.com
Tel: 775-882-2400
Tel: 800-654-5659
Fax: 775-882-7694
Made in the USA

A1014635 rev 1 © 4/03

Specifications subject to change without notice.