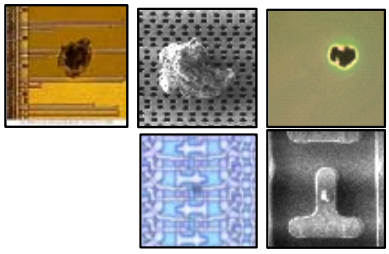
Industrial Inspection

Automatic Defect Classification for Semiconductor Wafer Inspection and Review

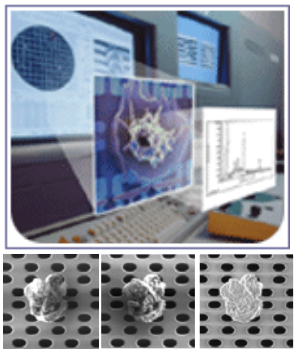
Rapid Yield Improvement Through Automation

Semiconductor wafer manufacturers invest much of their time in isolating the causes of yield-impacting defects during the lithographic printing and processing of integrated circuits on wafers. Automatic Defect Classification (ADC) automates the tedious manual process of defect review and classification during optical microscopy and scanning electron microscopy (SEM); a key step in the identification of the root cause of a manufacturing problems. ORNL has been working with the semiconductor industry since 1991 to provide new strategies, methods, and technologies for defect detection, segmentation, and classification for the purposes of process characterization, control, and rapid yield improvement.



Semiconductor defects range in size from < 100nm to >500μm and are different shape, sizes, and materials.

The ORNL ADC technology provides flexible investigation and development tools for front-end-of-line (FEOL) and back-end-of-line (BEOL) inspection and review environments and is used for both optical and SEM imaging modalities. The technology currently is in commercial use for SEM defect review and post-fabrication optical inspection systems.



ADC customization software module, Applied Materials, Inc., Defect Review SEM.

Base Technology

The ORNL ADC methods use extensive monochrome and multi-spectral features; principle component and linear discriminant feature analysis; and pair-wise, multi-class, and fuzzy implementations of k-nearest neighbor and radial basis function classifiers. A unique classifier training mechanism and interface provides intuitive visual and numeric feedback to assist in maintenance of defect libraries.

Specifications and Features

- Windows and UNIX libraries
- Standard image I/O (JPG, Tiff, BMP, etc.)
- Flexible feature selection and analysis
- Flexible classifier hypothesis testing

ADC for post-fabrication wafer inspection, Electroglas, Inc., QuickSilver IIIe.

Point of Contact:
Kenneth W. Tobin, Ph.D.
Group Leader, Image Science & Machine Vision
Engineering Science and Technology Division
Oak Ridge National Laboratory
P.O. Box 2008, MS-6010
Oak Ridge, Tennessee 37831-6010

Office: (865) 574-8521
E-mail: tobinkwjr@ornl.gov