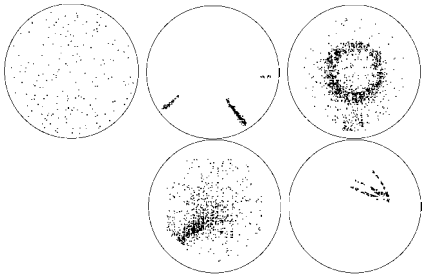
# Industrial Inspection

## Spatial Signature Analysis for Sourcing the Cause of Semiconductor Wafer Defects

### 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. After automatic in-line inspection of wafers at different process steps during fabrication, the distribution of defects across the surface can reveal useful information about errant processes that create unique patterns, otherwise known as signatures. A spatial signature is a unique distribution of wafer defects originating from a single manufacturing problem. Spatial Signature Analysis (SSA) automates the identification of these patterns and provides the yield engineer with the potential sources of signatures.



*Examples of spatial signatures on semiconductor wafers. These patterns have been detected and isolated using SSA.*

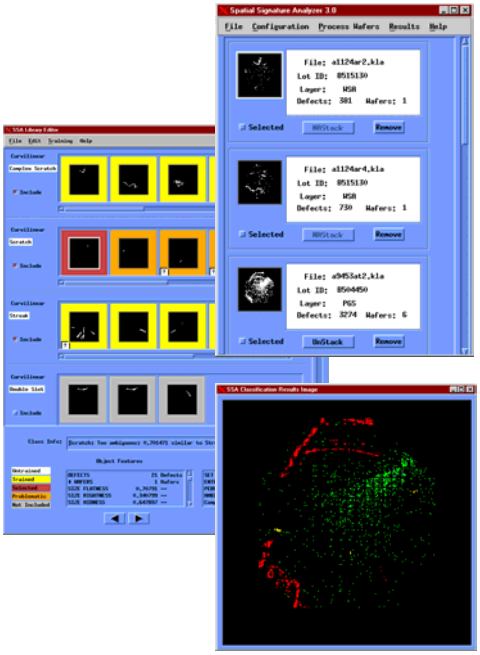
The ORNL SSA software (Release 7.1) provides flexible investigation and development tools for integration with factory data management systems, while supporting standard electronic wafer file formats and operating systems. The technology currently is in commercial use for in-line optical inspection of whole wafers, both patterned and unpatterned. The technology also has the capability of analyzing patterns in parametric data (e.g., electrical test codes, film thickness, critical dimension metrology, etc.).

### Base Technology

The ORNL SSA method uses morphological and rule-based spatial clustering with a trainable pair-wise, fuzzy k-nearest neighbor classifier.

### Specifications and Features

- Sun OS / Solarus – UNIX
- Standard electronic wafer format (e.g., KLARF)
- Motif 1.2x (GUI environment) / Rouge Wave Tools.h++
- Flexible classifier hypothesis testing
- Process wafer map < 10 sec



*SSA Release 7.1 software interface for wafermap input (top), training (middle) and output (bottom). The SSA software engine easily supports multiple interface methods.*

*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