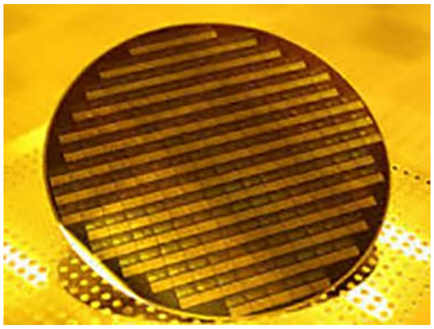
Detecting Manufacturing Defects on Semiconductor Wafers Using a Digital Microscope



Semiconductor Inspection

Semiconductors are essential components in many electronic devices. Semiconductor manufacturing can be broken down into two processes—circuit formation and packaging. Circuit formation begins with silicon ingots. The wafers used to form circuits are created from these ingots. These 'bare wafers' are then sliced to form discs.

To create a circuit, a bare wafer is oxidized, and then a complex, microscopic circuit is formed on it using a repetitive process that involves applying a photoresist coating, pattern printing, etching, impurity diffusion, and planarization. Defects can be introduced into the circuit during each of these stages. Common defects include irregular or nonuniform resist coatings, flaws, and foreign substances.

Challenges in the Inspection Process

Since wafers are produced quickly and in large numbers, they are normally inspected using an automated system. However, these systems can have inadequate optical resolution, making it difficult for the system to recognize small defects. Consequently, visual inspection using a microscope is a preferred option because they offer numerous observation methods:

- Brightfield (BF)
- Darkfield (DF)
- Differential interference contrast (DIC)
- MIX (a combination of brightfield and darkfield)

- Polarized light (PO)

Using these methods, an inspector can choose the one that best highlights hard-to-see defects. However, this process can still be challenging because the inspector must know which observation methods work best to find a given defect. Otherwise, the inspector must spend a lot of time trying out each method to find the best one. To simplify the inspection process, many manufacturers have switched from using optical microscopes to digital microscopes. While this can somewhat simplify the process, most digital microscopes still require the user to change lenses each time they change observation methods. And when you change lenses, it is easy to shift the observation position, forcing you to spend time refocusing.

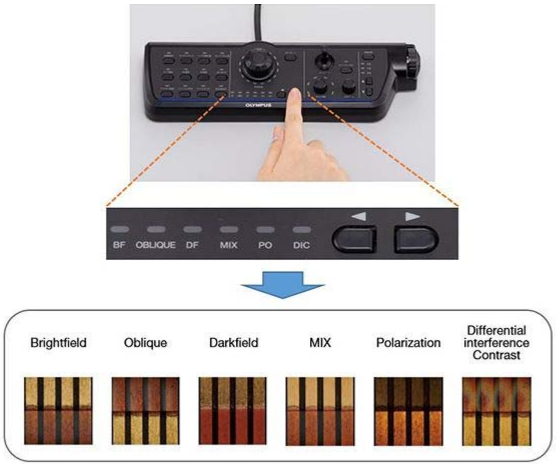
Simplify Semiconductor Inspection with the DSX1000 Digital Microscopes

Using a light microscope, filters must be added or removed from the microscope body to change observation methods.

Most digital microscopes cannot perform all observations with a single lens, so they need to be replaced, causing the observation position to shift.

Easy-to-use console

The DSX1000 microscope’s multifunction console enables fast, smooth analysis. By pressing a button on the console or clicking on the user interface, you can view a thumbnail display showing your sample under six observation methods. This makes it simple to choose the best image for your application, shortening inspection time.



One type of objective lens can handle most observation methods

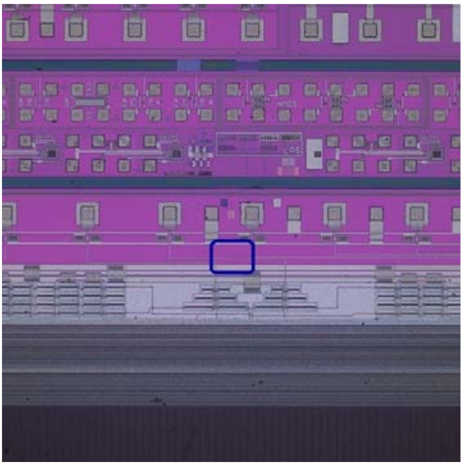
All observation methods are available on most DSX1000 objectives, so you can quickly confirm and select each observation image when detecting and analyzing wafer defects.

*To guarantee XY accuracy, calibration work must be undertaken by an Olympus service technician.

Example: Detecting a defect on a wafer (the defect is located in the box)

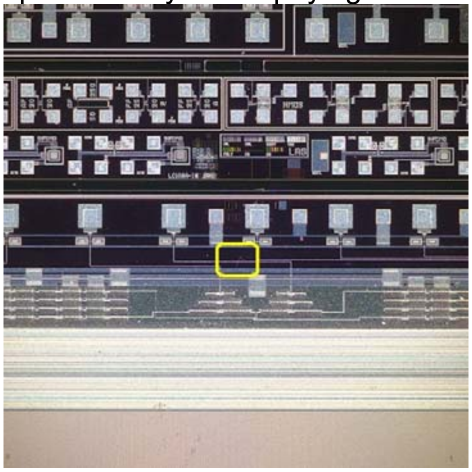
The images below illustrate a typical use case. A difficult-to-see defect is almost impossible to spot under some observation conditions. In the past, an inspector would need to spend a long time trying different observation methods until he or she finds the right one.

This defect is challenging to spot because it blends into the background



Brightfield observation: Defect detection at low magnification (70X)

Using darkfield, the defect is slightly easier to see, but still difficult to spot unless you are paying careful attention.

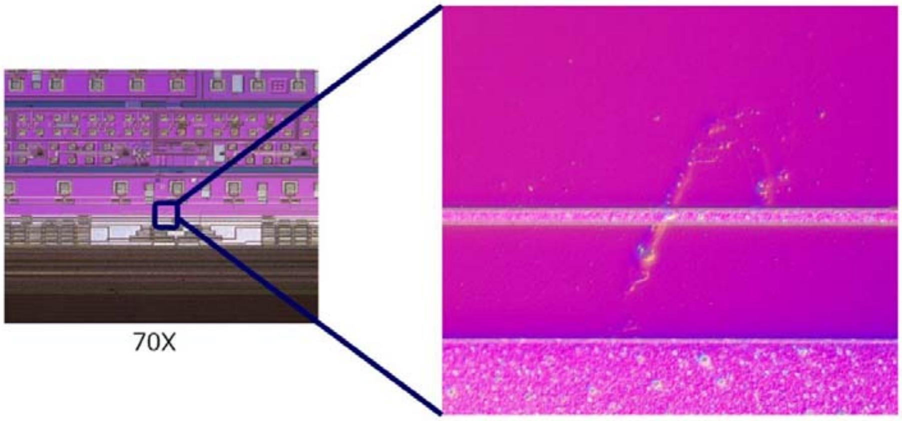


Darkfield observation: Defect detection at low magnification (70X)

With DIC, the defect can be clearly identified.

DIC observation: Defect detection at low magnification (70X)

Detailed inspection at high magnification



1500X

By zooming in, it’s clear to see
where the defect is located

Products used for this application

DSX1000

Better images and results. DSX1000 digital microscopes enable faster failure analysis with accuracy and repeatability.

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