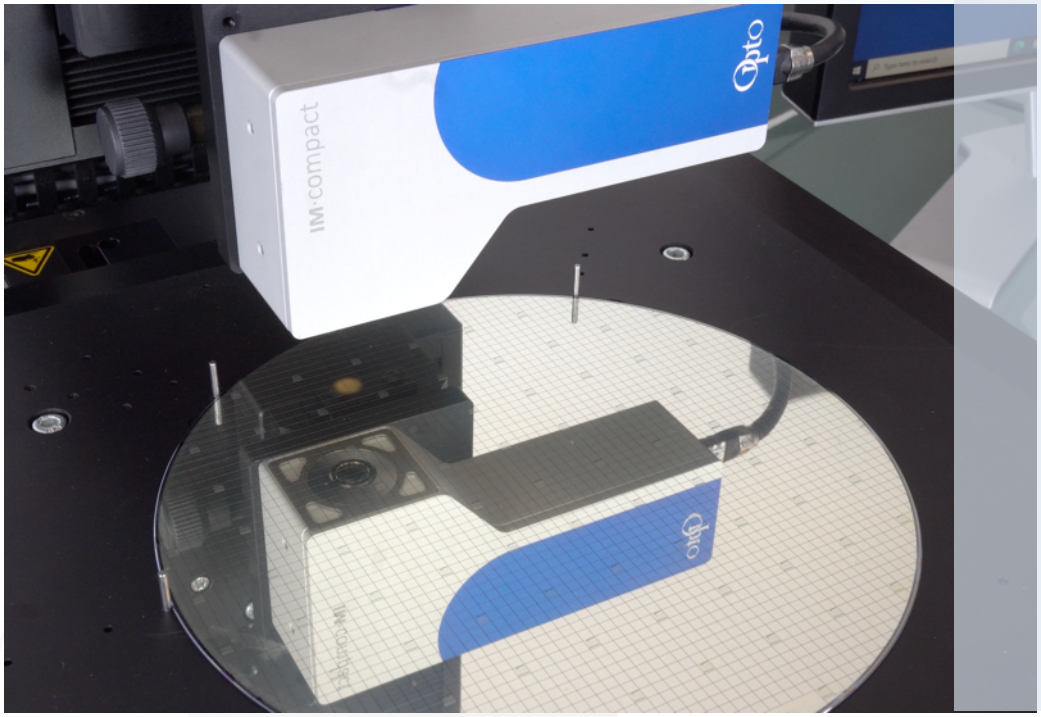
Wafer and PCB Control

with Opto's 'Machine Vision Microscopes'



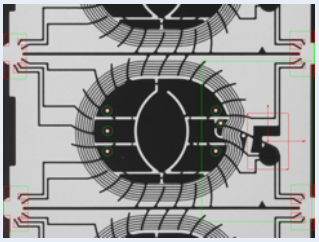


Fig. 1: Imaging Module compact M IC10-05o33MU3101 with 37mm WD

Electronics are an essential part in nearly every device we are using daily. The demand is high, the volumes huge, the size miniaturized, the price normally quite low, but the high throughput inspection needs throughout all the production steps are extremely high and must be fully automated.

The optical inspection is – besides the electrical testing – one of the most important technologies in all Quality Control levels. As the Opto Imaging Modules are pure plug & play digital microscopes, they are by nature done for integration into AOI machines and for the need of digital manual inspection.

Here some more detailed explanation of how our machine vision microscopes (Opto Imaging Modules with microscopic magnification higher than 1x) could assist in optimizing the optical defect screening.

PCB Inspection

The new Opto Imaging Modules could be easily integrated in every machine or workstation for accurate printed circuit board (PCB) quality control, rework, failure analysis or documentation process. The time for optical microscopes is over, the operator wants to work purely on a screen and the Quality department wants Industry 4.0 compliance. The new machine vision microscopes have a LED coax- and ring light integrated.

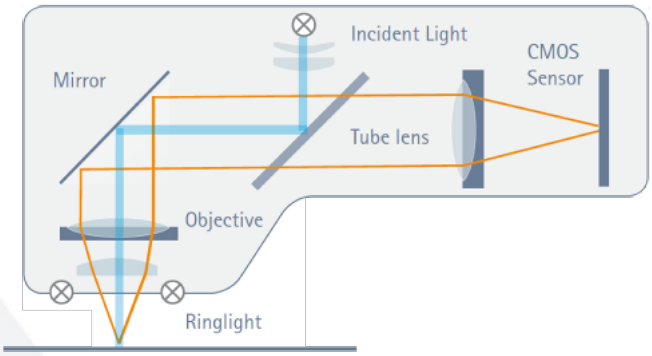


Fig. 2: Coaxial LED serves as incident light bright field illumination, the integrated ring light as incident light dark field illumination

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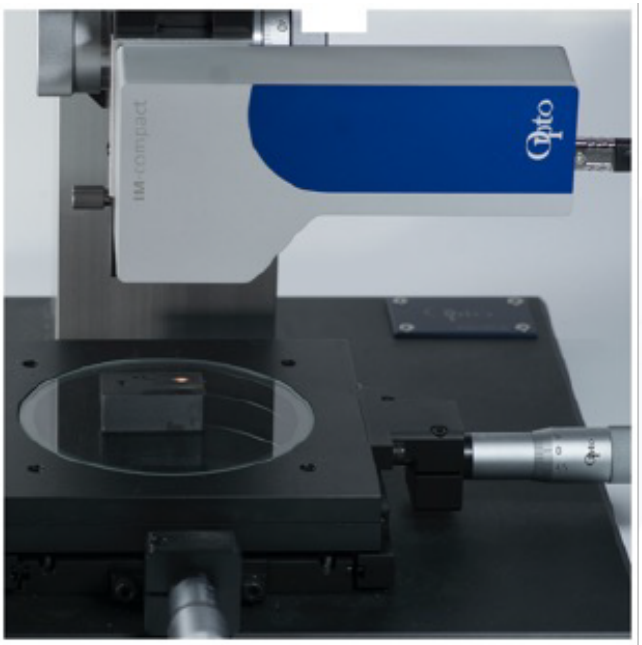


Fig. 3: IM · compact M with coaxial (left) & ring light illumination (right)

The IM•linea M Imaging Module with a bigger FoV , or the machine vision microscope compact M could be considered as pure digital microscopes for single-sided, double-sided, or multilayer PCB inspection.

Normally the components to be inspected are LED diodes, IC`s, FPGA Chips, capacitors, plastic leaded chip carriers (PLCC) or ball grid arrays (BGA) to name only a few.

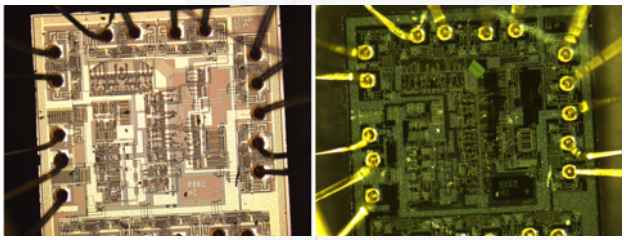
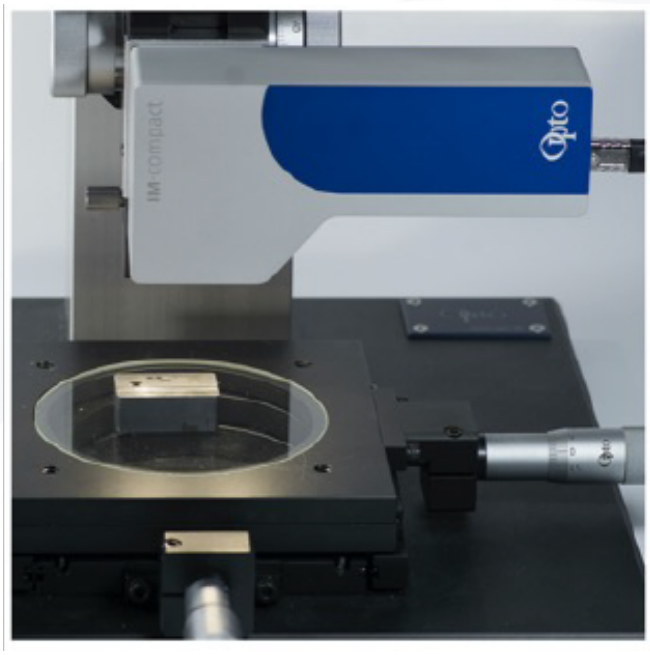


Fig. 4: Wafer details with coaxial brightfield on the left and contamination and wire details with ring light darkfield on the right image

Typically soldering defects are in the focus of optical PCB inspection. With the Imaging Modules you can equip scan stations, classify failures like cracks, short circuits, defect electrical connections, bridges between components or other anomalies on the board. Often the modules are used for post bond inspection or post reflow inspection.



Besides this typical microscope tasks, and automated measurements like pin counts, pin distance control, components identification or identifying wrong polarity assemblies could be done with the Imaging Modules.

Fig. 5: Opto IM · Series for quality assurance automation

The free available OptoViewer 2.0 Software allows quick and reliable Pixel to Pixel measurements as the IMs are all pre calibrated. Easy annotations and different image storage options are available to fulfil strict documentation rules.

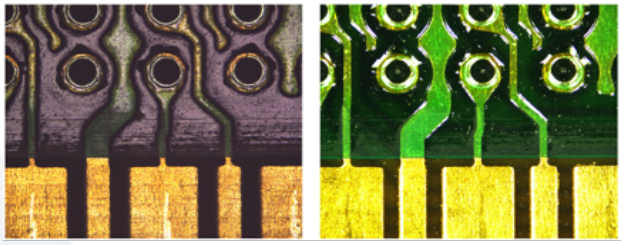


Fig. 6: For some applications – like here structures on a PCB – the IM compact M creates DIC effects because of the perfect colour correction

"Time is money", that's why the Imaging Modules allow cost-effective QC:

- All modules are more compact than regular digital microscopes
- Optimized for mobile use
- An image in 2 Minutes on a mobile computer
- Pre calibrated so immediate measurements are possible
- Fatigueless inspection for one or more users on monitor
- Highest image quality with huge color repeatability
- Less expensive than microscopes with similar optical quality
- Robust with integrated LED`s and no moving parts
- Perfect mix between working distance, magnification, and size to perform best ergonomics
- One unit, all embedded, born digital
- Image acquisition, measurement, easy save options and intuitive use of the Software

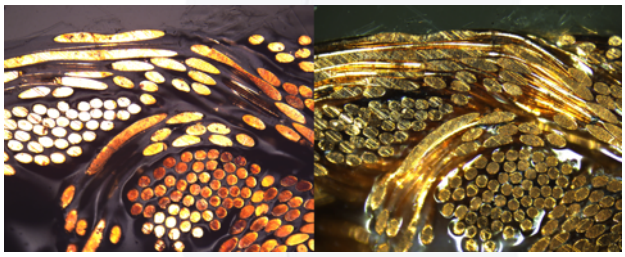


Fig.7: Colour crimp images - IM · bright field (left) vs. IM · dark field (right)

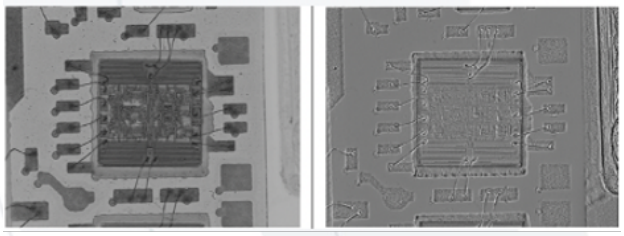


Fig.8: Defect identification using the Opto own solino computational imaging algorithms

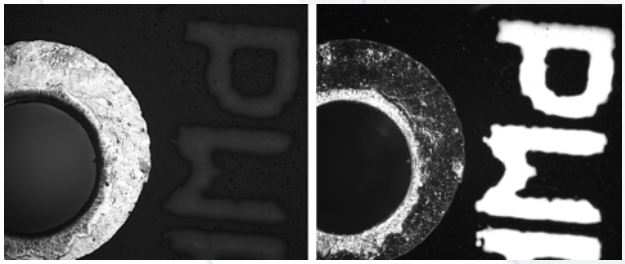


Fig. 9: Like here with a welded hole in a PCB the bright – and darkfield LED option has significant contrast effects

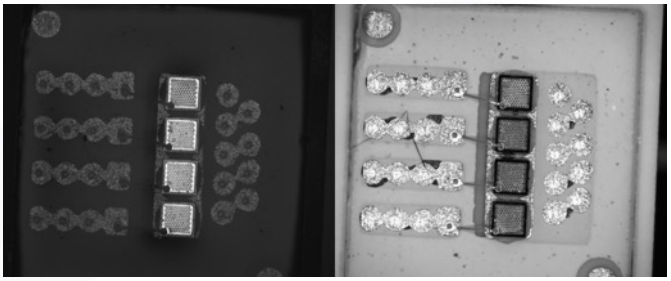


Fig. 10: High-contrast images are the basis for reliable image processing

Semiconductor Inspection

Semiconductors are the heart of every electronic device. In the production of these chips, we divide the front end in two different processes where the pure wafer is produced and then the backend where the separation and packing are executed.

The wafer is principally a silica disc that is processed in cleanrooms with high end machinery, that produce different layers of circuits with the steps of dispositioning, photo resist coating, lithography processing, etching, and ionizing with many cleaning steps in between, to then move to the packaging finally.

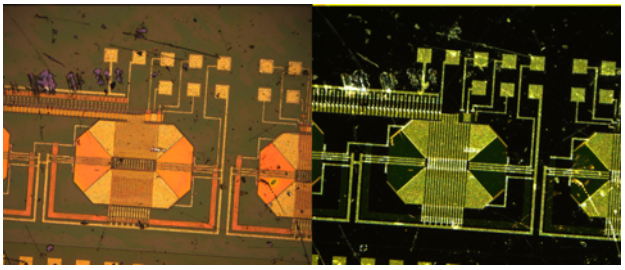


Fig. 11: Defect identification using different illumination concepts – bright-field (left) vs. dark field (right)

During these steps of complex processes in creating the microscopic circuits, several defects like irregularities in the coating, impurities, cracks due to stress or misalignment anomalies can occur. As the structures become smaller and smaller, in the nanometer range, only the bigger defects could be in the target for optical inspection within the visible range. The Opto Machine Vision Microscopes have theoretical resolutions down to 100 nm per pixel but normally in the range of 500nm per pixel and more are reasonable due to the limited pixel sizes of the camera. That also means only bigger defects like contaminations, particles, scratches, or structure analysis of bigger circuits could be addressed with the Opto Imaging Modules.

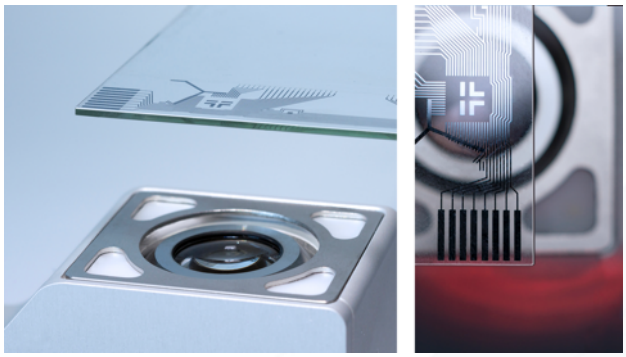


Fig. 12: For imaging transparent samples like photomasks also transmitted light imaging modules are available

As the semiconductor AOI must be done fast and normally in high volumes, image acquisition and processing speed is often a critical factor. Besides the needed resolution, also finding the right contrast technology is often a challenge. Brightfield (coaxial), Darkfield (ring-light) or more specialized techniques like DIC (Differential Interference Contrast) or illumination with polarizing filters in place are needed to visualize different features.

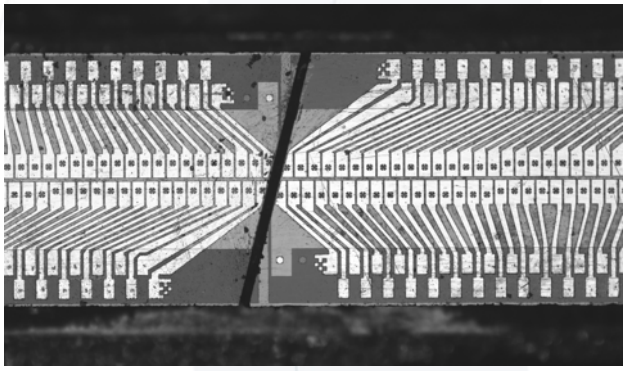
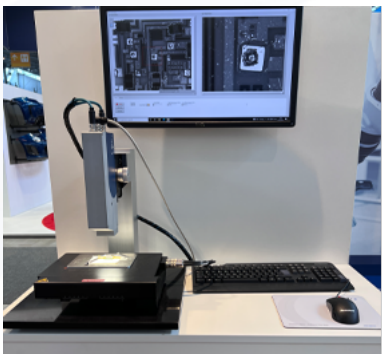


Fig. 13: The high end apochromatic corrected optic inside the modules highlights smallest details limited by the pixel resolution

Normally Opto can integrate every optical technology inside the Imaging Modules for OEM projects, but now only DF/BF LED setups with a mixture of coax light and a segmented ring light are available.
To summarize: the imaging modules are easy to integrate into every AOI machine due to the compact form factor. The price – the quality ratio – of these digital microscopes allows multiple usage in one screening system. Not all needed tasks like deep UV testing or huge FoV screening are possible as prices will increase, and different technologies must be applied. The big benefit is the reliability of the image itself.

Module by module is produced to the same high-quality standard and as nothing could be optically changed inside, also nothing could go wrong.



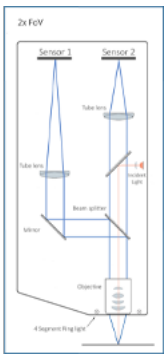


Fig. 14: Workstation with an Opto IM·linea XL

Especially the new IM•linea XL Imaging modules with two cameras integrated, an optical spread of 4x, and a 5LED controller allow overview- and screening imaging at the same time as well as combined illumination sequences to adapt the contrast to the application. So macro and micro imaging is possible at the same time with only one vision sensor.
This imaging modules substitutes conventional microscopes, but it also substitutes regular optical zoom systems with the two parallel 5MP color or b/w camera setups for one optical path. Here digital zooming becomes a completely different flavor.

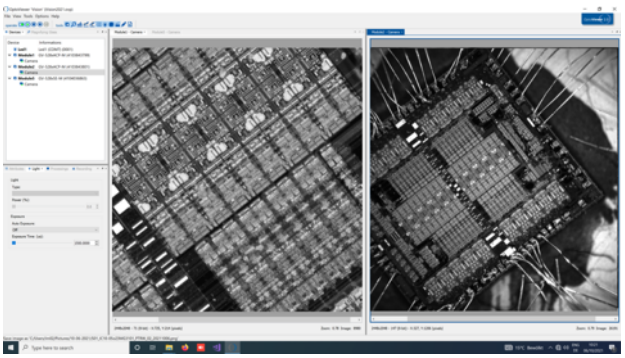


Fig. 15: The OptoViewer 2.0 allows simultaneous imaging of both cameras inside the linea XL module. Overview and 4x higher magnified details in full 5MP resolution due to the two separate optical paths.

In case of image analysis and image processing tasks, the machine builders are normally using the Opto SDK to drive the Imaging Modules directly with their SW. For smaller companies Opto can assist in writing own code or Opto can offer the development of whole user interfaces out of the Opto own SW platform Fortress as a service. For large sample imaging we can assist in driving external X-Y-Z stages as well as autofocus and stitching algorithms.

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