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Imaging for Professionals

Semiconductor wafer inspection using allPIXA wave

Application note

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Semiconductor wafer inspection with ingenuity: allPIXA wave

In semiconductor manufacturing yield is a critical parameter which drives cost. To improve the yield, manufacturers depend on in-line inspection systems, which can be deployed in every step of the semiconductor device manufacturing. Manufacturers inspect the products at many points between raw wafers and completed packaged ICs. The goal of the inspection system is to capture the defects at a very early stage. The shrinking geometries of the semiconductor devices challenge the inspection system capabilities to resolve the defects on micron and sub-micron scale.

To improve the yield, in-line inspection systems need to detect yield-limiting defects at limited inspection time. The trend is to have more points of inspection on the production line for every process step. Therefore, the performance of the inspection system is crucial for the overall production volume of the FAB.

There are two classifications of major defects in wafer inspection:

1) Micro Defects < 1µm
2) Macro defects > 1µm

Few Micro defects and nano scale defects can be measured only through time consuming microscopy techniques. Most of Micro defects can be identified indirectly by macro defects.

Using high resolution and high-speed machine vision cameras, inspection systems suitable to detect macro defects can be designed to enable 100% inspection of the wafer production. The high throughput can be realized by covering the full width of the wafer by a single acquisition. Deploying such macro defect inspection systems have various advantages:

- 100% in-line quality control / high throughput
- Direct feedback to process engineers enabling increased yield
- Traceability of every single wafer in different stages of the production
- Cost effective process control
- Fast return of investment

Types of defects captured with this scanner are **cracks, scratches, stains, chipping, saw lines, foreign particles, wafer peeling, incomplete dicing streets, defects after dicing (chip missing**).

Line scan technology plays a crucial role in building such macro defect scanners for wafer inspection. Chromasens line scan camera allPIXA wave color trilinear and monochrome with 3 stage TDI (Time delay Integration) with high resolution up to 15,360 pixels can make the scanners very effective on the production lines.

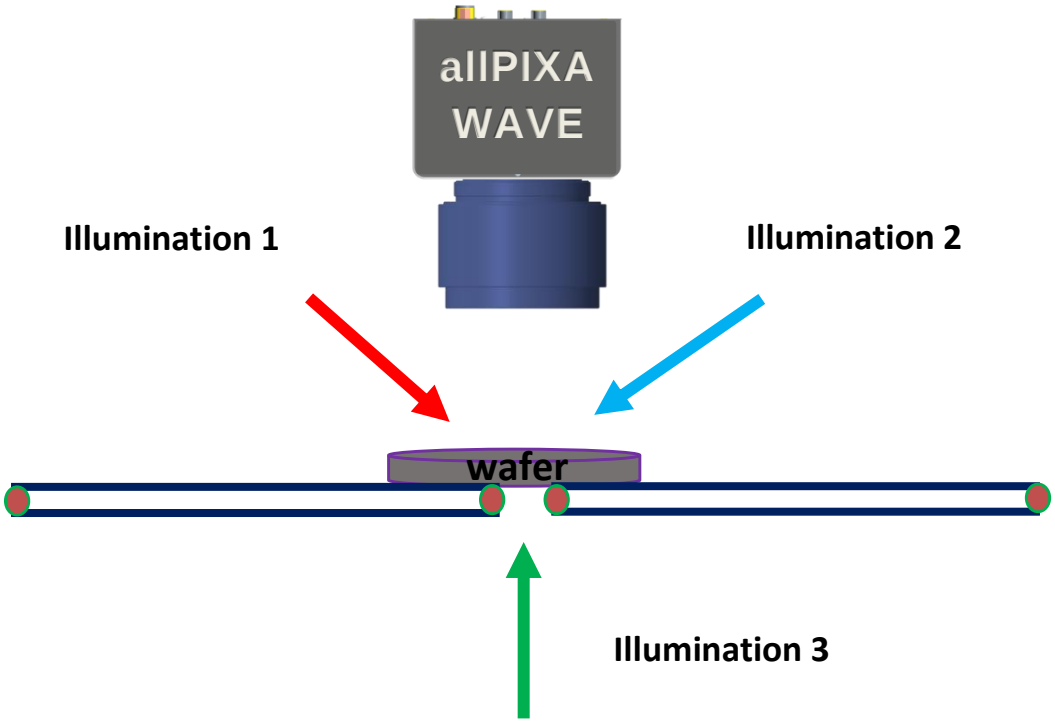
allPIXA wave 10K and 15K exclusive features:

There are two outstanding features of allPIXA wave cameras, which are dedicated for wafer inspection systems:

1) Master slave synchronization
2) Multi-channel flash control

Covering the complete FOV of a wafer of 300mm at a resolution of 5-15 µm/pixel requires multiple cameras to be perfectly synchronized and optical aligned. The Chromasens Master Slave camera synchronization feature allows to perfectly synchronize N=1,2,3,4,5,6 number of cameras. The perfect hardware-based line synchronization allows for more robust and simplified image processing pipelines.

Completing multiple acquisitions in single scan will save time and money for the integrators. The multi-channel flash control feature of allPIXA wave can acquire multiple images, whereas every image is recorded under different illumination conditions in a single scan. In addition, high color fidelity helps to achieve excellent results in defect detection. The high-quality color images can give more information about the defect class and extent of the defects on the wafer. Combining the multiple illumination in single scan gives inspection system an advantage to overcome the challenges of shiny surface on the wafer. Furthermore, the large full well capacity of the sensor enables a high dynamic range and the blooming resistance is outstanding, which is very import for strong local reflections in bright field configuration.



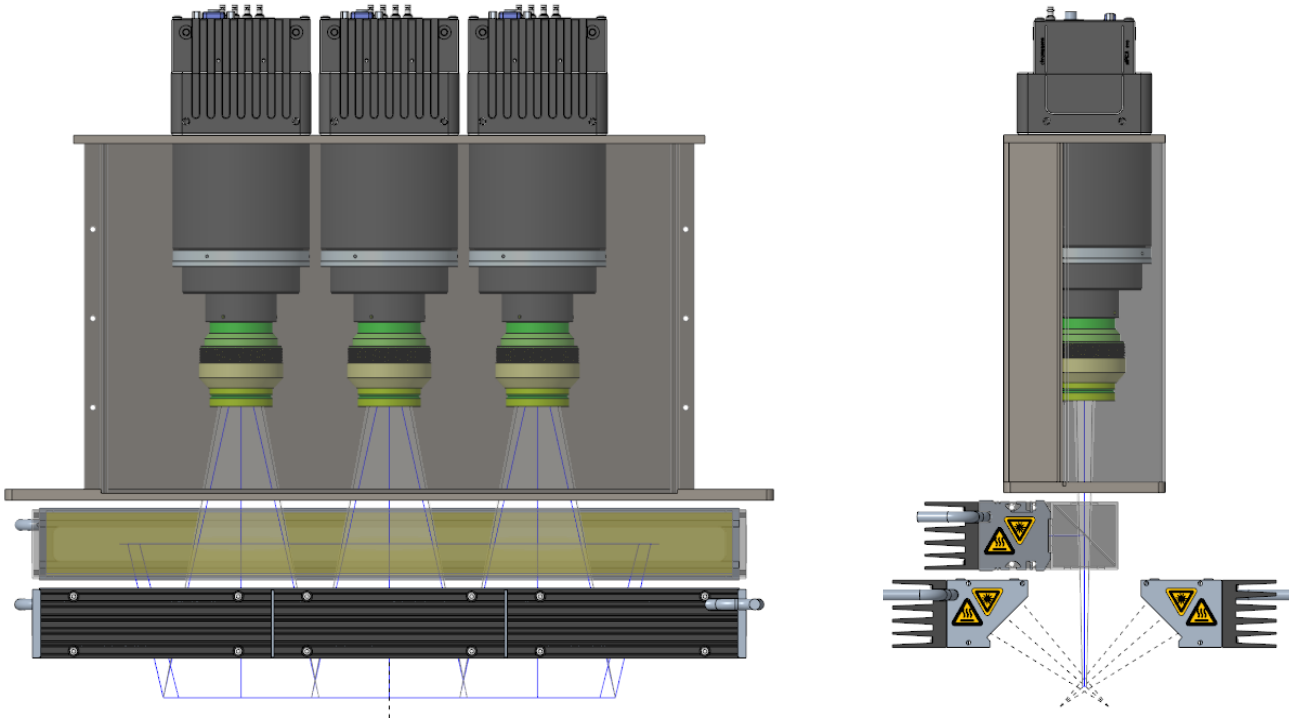
a) Multi-channel flashing of allPIXA WAVE enables the system to scan with up to four different type of illumination in a single scan. In one scan it is possible to acquire dark field, bright field backlight and additional coaxial illumination if needed. Please refer to paragraph 2

allPIXA wave delivers excellent image quality with its unique image processing features. Advanced automatic white balancing, gamma correction, in built color correction matrix are few features to be named. Keystone correction feature used when camera is in angle, this feature can be adapted in inspecting high bow wafers. Mono version of the camera can deliver 3 stage TDI feature.

Camera link interface is used by allPIXA wave, its unique capability is to have cable lengths up to 15 metres without any repeater. Camera link is a very reliable interface protocol and provides required data rates at very economical system cost.

Please refer to Chromasens webpage for viewing complete features of allPIXA wave: https://www.chromasens.de/en/product/allpixa-wave-15k

Multi - Camera Synchronization System examples



b) System example with multi camera synchronization (master – slave feature), in addition dark field and coaxial light integrated to make various defects detectable.

Chromasens offers complete solutions for inline- inspection systems. We offer custom built inspection systems that fit to your vision and production line requirements. Challenges of Integrating camera, optics, illumination, and other hardware components into one solution are solved for you by our team of experts.

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