

Pollux – The New Star for Particle Detection in the Wafer Fab!

RETICLES CAN BECOME CONTAMINATED THROUGH HANDLING AND TRANSPORTATION IN THE WAFER FAB. IN ORDER TO AVOID THE USE OF CONTAMINATED RETICLES IN A STEPPER, RETICLES NEED TO BE ROUTINELY RE-QUALIFIED. SABINE BÜNSOW OF GERMAN COMPANY DR SCHENK GMBH INTRODUCES POLLUX, AN AUTOMATIC PARTICLE DETECTION SYSTEM FOR RETICLES. DESIGNED FOR LOW COST, EASY HANDLING, AUTOMATIC INSPECTION AND FAST CYCLE TIME, A POLLUX SYSTEM CAN BE PLACED IN EACH CRITICAL AREA OF THE FAB TO INCREASE PRODUCTIVITY AND YIELDS

Photolithography is the process that transfers the geometric pattern needed to create the desired electrical behavior of an integrated circuit. This geometric pattern is contained on a reticle or photomask. One single integrated circuit may require up to several hundred layers of different patterns, each of which will require a unique photomask. This means that the photolithography process and its related process steps are very cost intensive as it may require up to several hundred production steps.

Throughout the entire semiconductor fabrication process, it is critical to minimise the amount of contamination that comes in contact with the wafers and the wafer processing equipment. Indeed, contamination control has become a major factor in manufacturing yield and profitability.

In order to guarantee a correct exposure, the photomasks have to be absolutely clean and free of any particles, as even small particles on a reticle can destroy the circuitry of an entire wafer. If this happens close to the end of the lithography process, not only all previous production steps (up to several hundred) would have been futile, but the whole wafer would be destroyed: a waste of time and money! For this reason, reticles need to be routinely re-qualified before they are used in lithography steppers.

Fast and fully automatic

Dr Schenk's Pollux automatic particle detection system for reticles is designed to be integrated into bare reticle stockers, wafer steppers, cleaning stations or to be used as a stand-alone system. Conventional reticle

inspection systems are designed to also inspect the reticle structure. These systems require high capital investment and represent a high cost of ownership. Pollux, by contrast, concentrates on the function of inspecting the surfaces of the reticle.

The surfaces of the glass side and the protective pellicle side are inspected simultaneously for imperfections down to $10\mu\text{m}$ equivalent sphere diameter (ESD). Particles and defects such as dust, hair, fibers, fingerprints, scratches and pinholes in the pellicle can be detected. The height of the pellicle frame and the inspection area (holding the geometric pattern of the IC) differ from reticle to reticle in size and form. Pollux detects the frame height and the inspection area and adjusts the focus of the imaging sensor automatically. The complete inspection including frame detection and autofocus typically takes less than 1 minute. If the reticle is already programmed into the

machine (this means that frame detection and autofocus took place during a previous inspection) the complete inspection can even take less than 35 seconds.

Due to the low amount of capital investment and small cost of ownership, wafer fabs will be able to position this particle detection system in each critical area of the fab. The risk of contamination or damage is therefore minimised as the reticles do not have to be transported for inspection purposes to a central area where a reticle inspection system is usually installed.

Operation

From placing the reticle pellicle side down in the drawer, the photomask is automatically moved into the inspection chamber. The pellicle frame is recognised and the focus of the imaging sensor is adjusted. While the reticle is returned to its original loading position, the glass and pellicle surfaces are

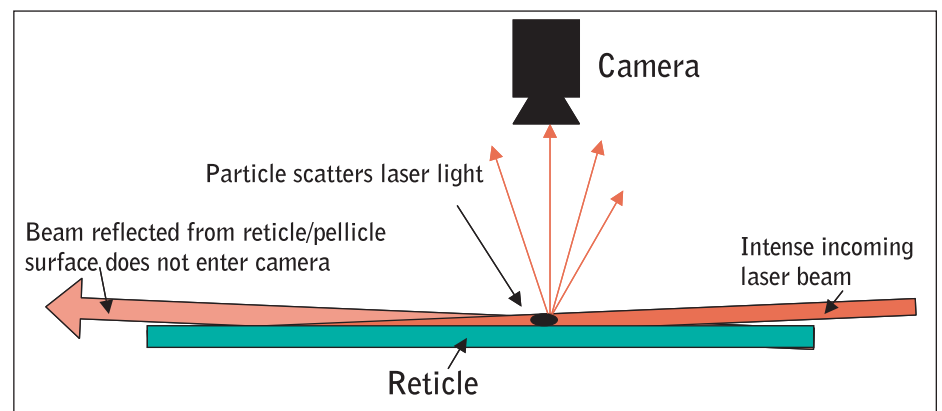


Fig.1: Simplified illustration of far dark-field laser inspection principle

scanned line-by-line simultaneously. The scanning lines are illuminated with focused high-power solid-state laser diodes based on a far dark-field laser inspection principle. The surfaces are illuminated under a very shallow angle from the left and right side.

Highly sensitive CCD line scan cameras detect all scattered light from any imperfection. Based on the number and intensity of bright pixels, the particles are classified.

Pollux reports the number of detected

particles on the glass and pellicle side (separately or combined) and displays a particle histogram. The particle location is displayed in the defect map. A gray-scale image of each selected particle is displayed on the operator's screen.

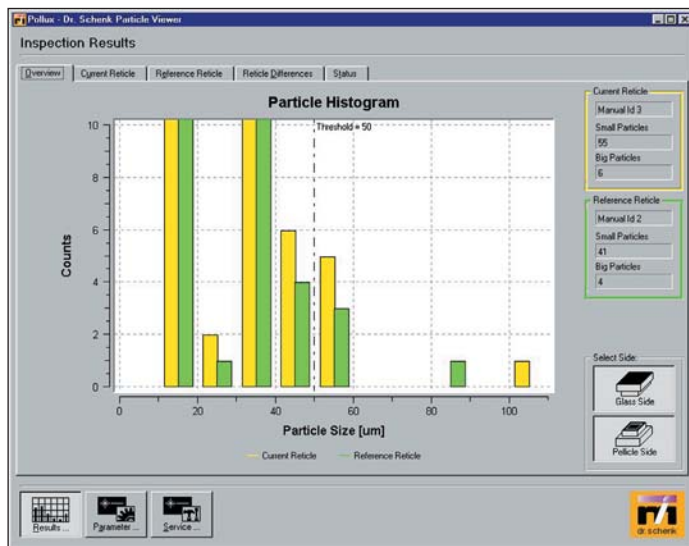


Fig.2: Particle Histogram

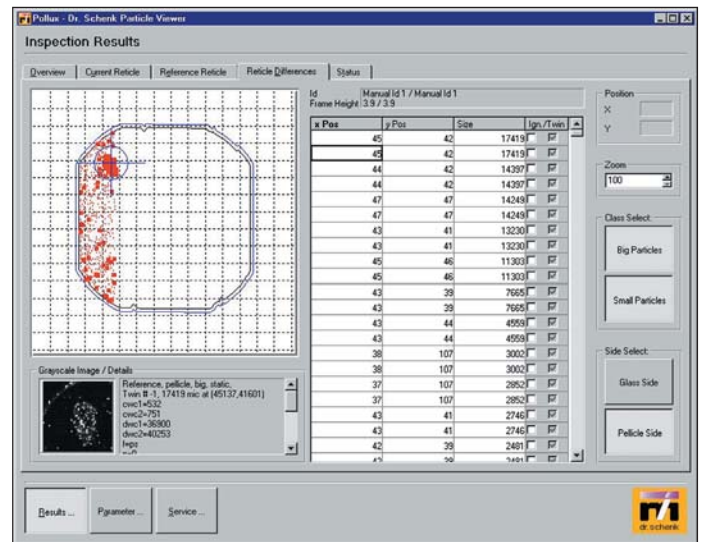


Fig.3: Defect Map and gray-scale image

Because of its small footprint, Pollux can be easily integrated into any handling system. Pollux is designed for class 1 cleanroom operations and no regular maintenance is needed thus minimizing operation cost. The system possesses a self-check and preventive

maintenance alert which offers maximum uptime.

The measurement repeatability was evaluated based on 200 successive inspections. Tests have proven that repeatability is better than 90% for particle

sizes 10-20µm and even better than 98% for particle sizes larger than 20µm.

Pollux is not intended to replace common reticle inspection systems but rather as a complement to bare reticle stockers, wafer steppers or cleaning stations for reticles.

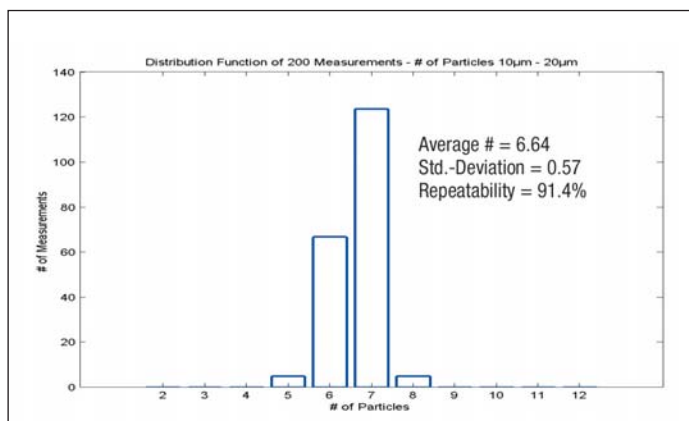


Figure 5: Repeatability for particles 10µm-20µm

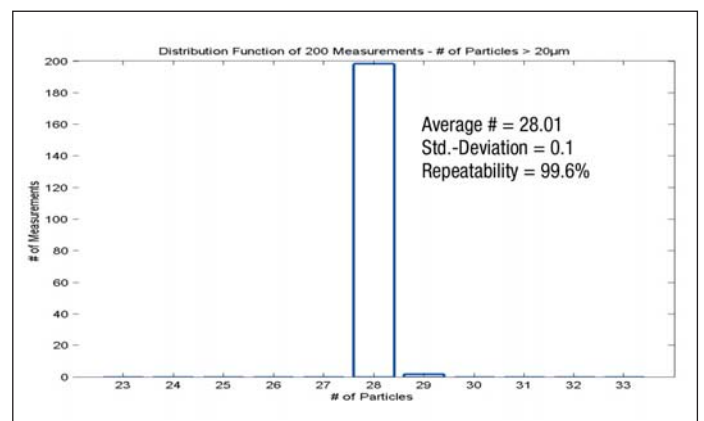


Figure 6: Repeatability for particles > 20µm

About the company

Dr. Schenk GmbH is an innovative high-tech company headquartered in Munich, Germany and has a high reputation in the inspection system market for optical media products, flat panel displays and web products. Dr. Schenk has an experience of more than 17 years in developing and manufacturing

automatic Inspection Systems for quality and process control. Dr. Schenk has already sold more than 6000 systems worldwide and has established a worldwide presence of technical service centers and representative offices in order to provide the best possible support to its customers.

For further information, please contact:
 Dr. Schenk GmbH, Industriemesstechnik,
 Einsteinstr. 37, 82152 Planegg/Martinsried
 Germany
Tel: +49 89 85695-113
Fax: +49 89 85695 200
e-mail: sales@drschenk.com
URL: http://www.drskenk.com