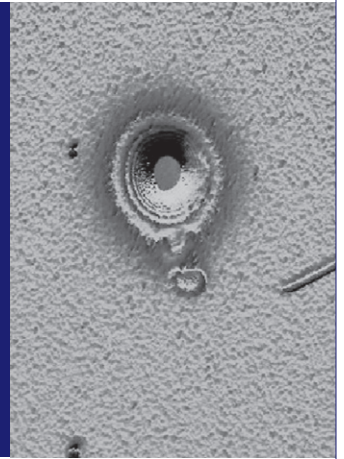**KLA-Tencor**

Accelerating Yield

CANDELA CS20

OPTICAL SURFACE ANALYZER

Advanced Inspection for Compound Semiconductor
and Optoelectronic Materials

KLA-Tencor
Accelerating Yield

CANDELA® CS20 SERIES

The KLA-Tencor Candela CS20 series optical surface analyzer (OSA) performs advanced surface inspection for semiconductor and optoelectronic materials. The CS20 series delivers process control and yield improvement for inspection of both opaque substrates such as Si, GaAs, and InP, as well as transparent materials such as SiC, GaN, sapphire, and glass.
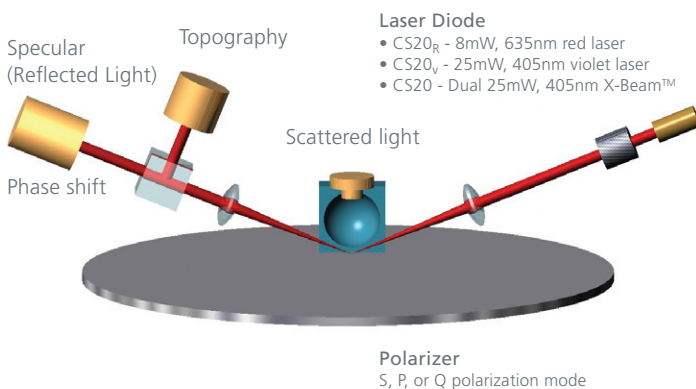
The CS20 series employs proprietary OSA technology to simultaneously measure scatter intensity, topographic variations, surface reflectivity and phase shift for automatic detection and classification of an increasing library of defects of interest (DOI). The OSA inspection technique combines the elemental principles of scatterometry, ellipsometry, reflectometry, and optical profilometry to nondestructively inspect wafer surfaces for residual contamination, surface and subsurface defects, topographic variations and film thickness uniformity. The CS20 series' high sensitivity, throughput, and versatility offer a cost-effective solution suitable for both process development and manufacturing process control.

- Single-tool solution that combines four optical inspection techniques in a single scan for maximum efficiency in automated defect detection and classification

- Meets multiple industry requirements including HBLED, High-Power RF Electronics, and Glass Display Technologies

- Throughput up to 40wph for 2" wafers and 20wph for 8" wafers

- Advanced algorithms for defect classification of over 30 DOIs across a variety of materials

- Rapid, full-wafer roughness monitoring and surface uniformity mapping

Candela CS20

OPTICAL SURFACE ANALYZER

Candela OSA System

Specular
(Reflected Light)

Topography

Laser Diode
- CS20$_R$ - 8mW, 635nm red laser
- CS20$_v$ - 25mW, 405nm violet laser
- CS20 - Dual 25mW, 405nm X-Beam™

Scattered light

Phase shift

Polarizer
S, P, or Q polarization mode

Four signal detection channels enable a wide variety of inspection applications and defect classifications.

Defect control and process uniformity are critical to process development and device yield enhancement. Contaminants such as particles and stains may alter film characteristics or cause adhesion problems for subsequent layers. Surface and subsurface defects such as pits, scratches, bumps, crystal defects or excessive surface roughness can impact subsequent processes and substantially degrade device performance and yield. The Candela CS20 series is highly sensitive to a wide variety of defects and can be used at multiple steps for immediate process feedback. Candela images can be used for visual inspection or for automated generation of detailed defect maps and reports. Substrates, epi layers, and film coatings can be inspected for topographic anomalies, processing residues, point defects and film uniformity. The CS20 series offers an automated solution for inspecting product directly at multiple processing steps, eliminating the need for destructive testing and wafer monitoring through time-consuming manual inspection.

Advanced Surface Analysis

The proprietary OSA optical system combines multi-channel detection methods to measure the scatter, reflectivity, phase shift, and topographic variations across the surface. The CS20 series rapidly scans the surface to produce a high-resolution image of the scanned region for up to 100% wafer surface coverage. The resulting image enables measurement of global uniformity and detection of localized defects. For surface inspection applications, multiple measurements are made simultaneously then analyzed to detect and classify different types of defects. Analysis recipes offer flexible inspection criteria and allow user-programmable defect

definitions. For example, during inspection of polished substrates, the inspection recipe may include particles, slurry residues, scratches, and pits. Some substrates may have very specific defects of interest such as micropipes, carrots, triangles, and polytype defects in SiC materials. After epitaxial growth, focus may shift to analysis of pre-and post-epi scans for identification and impact of source defects. Other processes such as thin film coatings need to be free of embedded particles and pinholes. By design, Candela technology offers great flexibility and accommodates a wide range of materials and processes.
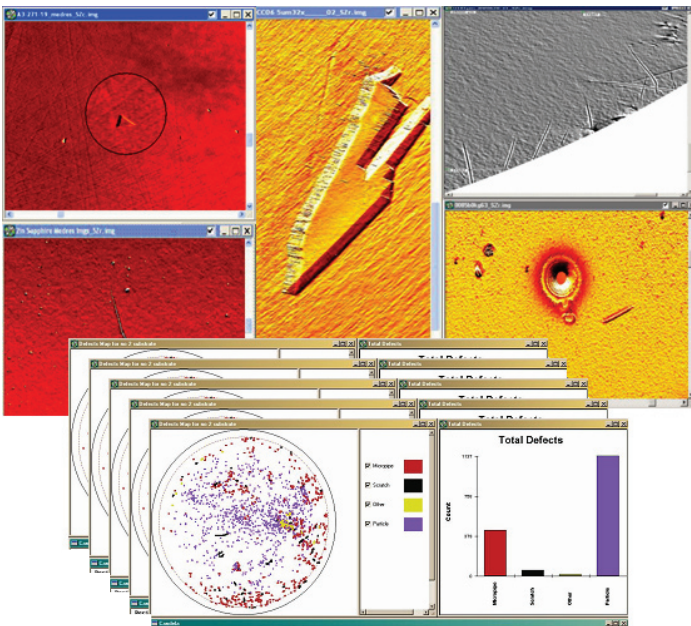
Choose best detection channels and resolution to capture defect.

Use thresholding and stitching to separate defects from background.

Use defect parameters and tests to classify detected features into defect types.

Display simple map, count histogram, and log file.

| SCAN | DETECT | CLASSIFY | REPORT |

Advanced 4-channel microscopy for defect analysis and identification of mission-critical Defects of Interest (DOI).

Defects shown include: SiC triangle defect, sapphire substrate scratch, SiC polytype defect, wafer edge scratches, and GaN epi pit.
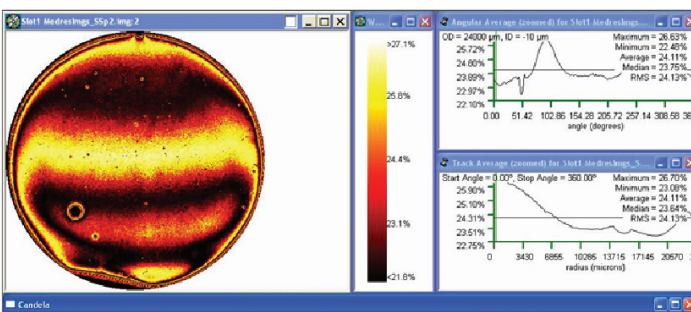
Automatic Defect Classification software provides the most advanced recipe creation available for DOI classification.

High-throughput scanning analysis delivers summary reports including defect maps, log files and automated pass/fail assignments. Defects are classified and binned by size into user-defined categories and displayed on the Candela defect map.

GaN on sapphire epi uniformity map.

High Brightness Light Emitting Diodes (HBLEDs)

The Candela CS20 is the first automated wafer inspection system designed for the defect management requirements of the HBLED market. The platform is designed for inspection of transparent materials such as sapphire and GaN and can detect a wide variety of yield impacting defects such as substrate scratches and stains, epi-layer pits, crosshatch, crystal cracking, topographic anomalies and epi-layer uniformity.

Inspection is performed at throughputs of up to 40 wafers per hour, enabling for the first time a true production line monitor for wafers used to produce HBLED devices. The automated defect classification capability allows customers to filter out nuisance defects and quickly zero in on mission-critical defects of interest. As a result, HBLED manufacturers can conduct more rapid root cause analysis to speed process development, as well as quickly fine-tune production processes to optimize yields and achieve higher revenues per wafer.
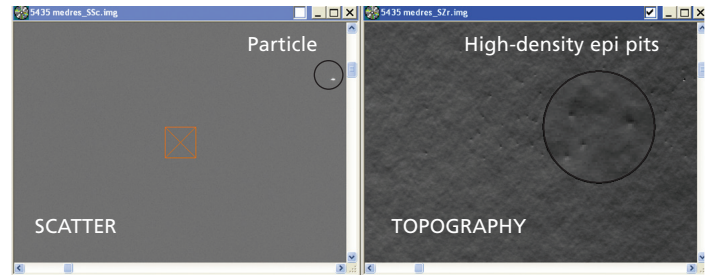
High-Power RF Devices

The CS20 series are the most advanced tools on the market for detection and classification of critical GaAs defects — from epi defects such as pits, rings, and bullseyes to substrate level defects including crystal slip and polishing stains. The Candela OSA technology is extremely sensitive to GaAs substrate stains, many of which can go undetected under microscope or bright light inspection. Various stains have been identified as killer defects resulting in poor epi adhesion and rough epi morphology. Uncorrected stain defects are resulting in full wafer scraps throughout the industry supply chain. GaAs industry leaders are using Candela OSA technology to identify mission critical stains of interest and create process-specific recipes to detect and classify killer stains while ignoring nuisance stains.

SiC and GaN-based Shottky Diodes and Field Effect Transistors (FETs) present new challenges for metrology and inspection. Optically transparent substrates and films cannot be inspected with conventional darkfield tools since backside contamination and scratches cannot be distinguished from frontside defects. Conventional techniques used to reveal defects in SiC include KOH etching, SEM and AFM analysis. Most methods are not practical for manufacturing purposes and new production monitoring tools are required to help this emerging class of devices move into cost effective, volume manufacturing. The CS20 series is designed to meet the needs of the SiC and GaN-based materials. Today over half of all SiC wafers produced worldwide are inspected with Candela OSA technology.

Scatterometry-only based metrology tools would lead the user to believe that the surface is virtually defect-free when in actuality the epi-layer is heavily populated with pits as detected in Topography channel.
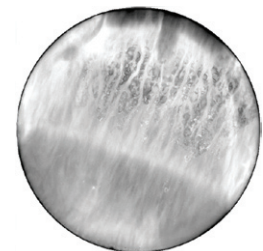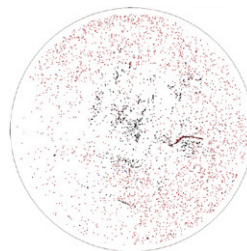
Defect Map vs Candela Imaging
Substrate stains as seen in Phase channel. Stains not visible under microscope or bright light inspection.

Coated Glass (CMOS imagers, LCoS chips, etc.)

Increasingly demanding specifications for specialty coatings on glass (Conductive ITO, Anti-Reflective, Polyimide, etc.) are pushing current visual inspection methods to their limit. High volume production of devices such as CMOS imagers and LCoS displays require a quantifiable, automated inspection and metrology capability to control yield. The manual or semi-automated visual inspection techniques in use today cannot meet these needs, but conventional tools (optical microscope, ellipsometer, profiler, etc.) do not provide 100% surface inspection capabilities required for optimized process yield. The Candela OSA uses multiple measurement methods simultaneously to capture DOIs with 100% surface coverage.

The KLA-Tencor Solution

KLA-Tencor's Candela series Optical Surface Analyzers (OSA) provide critical analysis capabilities. Using an innovative proprietary design of darkfield and brightfield detectors, the Candela systems can detect and classify a wide range of user-defined defects of interest. Full wafer analysis of surface roughness as well as thin-film and epi uniformity can also be performed with the Candela OSA systems.

KLA-Tencor also offers a low-cost, manual-load Candela CS10 series.

KLA-TENCOR SERVICE and SUPPORT

Customer service is an integral part of KLA-Tencor's portfolio that enables our customers to accelerate yield. Our vast customer service organization collaborates with worldwide customers to achieve the required productivity and performance at the lowest overall cost. K-T Services includes comprehensive contracts, time and materials, spares, asset management, customer training, and yield consulting.

OPTICAL SURFACE ANALYZER

KLA-TENCOR CORPORATION
One Technology Drive
Milpitas, CA 95035
phone +1 408 875 3000
www.kla-tencor.com