

INM300



Automated 300mm High-Resolution UV/DUV Review Microscope

Optical Review of 300mm Wafers and Masks

INM300

Automated 300mm High-Resolution UV/DUV Review Microscope

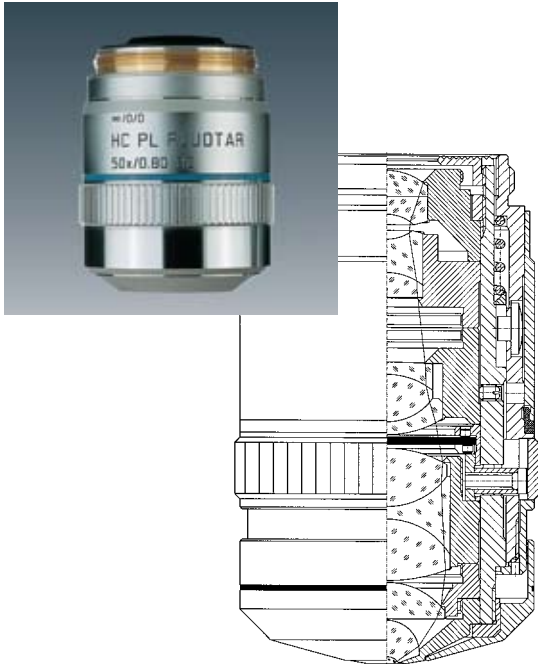
OVERVIEW

Fully automated optical microscope with UV, and Water Immersion

The semiconductor industry, with its shrinking feature sizes and increasing substrate dimensions, has created a twofold challenge for semiconductor inspection equipment manufacturers — how to handle large substrates safely, and provide excellent imaging quality. The KLA-Tencor INM300 meets this challenge by handling wafers up to 300 mm and masks up to 9", while at the same time providing the capability to observe micron details with dimensions down to 60nm all on the same platform. This inspection and measurement tool is a sophisticated, high performance microscope providing brightfield (BF), darkfield (DF), differential interference contrast (DIC), ultra-violet (UV) (365 nm), deep ultra-violet (DUV) (248 nm) and DUV Water Immersion imaging. The INM300 offers a comprehensive solution to all your inspection and imaging problems, with field-proven optical performance, user-friendliness, ergonomics and cleanliness ideal for both research labs and production environments. In addition to its standard capabilities, the INM300 offers the possibility of custom-tailored configurations.

- Superb HCS optics for visible light, UV and DUV provide crisp and high contrast images with highest resolution
- Real-time autofocus with upper end-switch for sample protection
- Imaging modes from brightfield, darkfield, DIC, 365nm UV, and 248nm DUV and DUV Water Immersion with automated controls
- 150x/0.90 UV (365nm) objective with 130nm resolution
- Cement-free, 150x/0.90 DUV (248nm) objective with 80nm resolution
- Cement-free 200x/1.25 DUV water immersion objective with 60nm resolution
- Long Working Distance L50x DUV cement-free objective for thorough pellicle inspection of masks
- Upper limit focus stop for sample protection
- Modular system configurations for all wafer sizes with manual or scanning stages
- User-friendly VISCON software packages for semi-automated inspection and review





THE OPTICS

The Optics

Developments in semiconductor manufacturing and microelectronics industry, and the increasing use of CCD technology and electronic image processing, have to be matched by intelligent technical adaptations of the microscope system. KLA-Tencor, best known for innovative optical solutions, offers the HCS optics concept. HCS (Harmonic Component System) indicates that all components contributing to the optical performance (e.g., objectives, tube lenses, tubes, eyepieces, TV-camera adapters, etc.) have been optimized and, with regard to minimizing optical failures, harmonized throughout the entire optical system. The implemented solution leads to a microscope with an unmatched optical capability. The outstanding features of the HCS are higher numerical apertures, optimized field flatness and reduced astigmatism, for both the image in the eyepieces and the high quality TV-exit. The HCS optics delivers through the highest optical resolution, optimum contrast and clear and brilliant colors over the entire field of view of 25 mm.

Objectives for the Vistec INM300

The field-proven HC PL FLUOTAR objectives with semi-apochromatic correction produce an uncompromisingly bright and high-contrast image in all imaging methods in visible light. Together with the highest quality PL APO, PLAN FLUOTAR L series with extra-long free working distances, and UV and DUV objectives with highest numerical apertures for dry (non-immersion) lenses, the INM300 offers the most specialized and complete magnification row for semiconductor applications.

Type	Mag./Aper.	FWD	BF	DF	DIC
N PLAN	2.5x/0.07		X		-
N PLAN	5x/0.12	14.0	X		-
N PLAN	5x/0.12 BD	13.2	X	X	-
N PLAN EPI	10x/0.25	17.6	X		-
N PLAN EPI	10x/0.25 BD	16.2	X	X	-
N PLAN	20x/0.40	1.1	X		D
N PLAN	20x/0.40 BD	1.1	X	X	D
N PLAN	50x/0.75	0.37	X		D
N PLAN	50x/0.75 BD	0.37	X	X	D
N PLAN	100x/0.90	0.27	X		D
N PLAN	100x/0.90 BD	0.30	X	X	D
PL FLUOTAR*	1.6x/0.05	1.54	X		-
PL FLUOTAR	2.5x/0.07	9.2	X		-
HC PL FLUOTAR	5x/0.15	12.0	X		D1
HC PL FLUOTAR	5x/0.15 BD	12.2	X	X	D1
HC PL FLUOTAR	10x/0.30	11.0	X		D1
HC PL FLUOTAR	10x/0.30 BD	11.0	X	X	D1
HC PL FLUOTAR	20x/0.50	1.27	X		D1
HC PL FLUOTAR	20x/0.50 BD	1.27	X	X	D1
HC PL FLUOTAR	50x/0.80	0.50	X		D
HC PL FLUOTAR	50x/0.80 BD	0.50	X	X	D
HC PL FLUOTAR	100x/0.90	0.27	X		D
HC PL FLUOTAR	100x/0.90 BD	0.30	X	X	D
HC PL FLUOTAR	150x/0.90	0.25	X	-	C
PL FLUOTAR L	20x/0.40 BD	10.7	X	X	C
PL FLUOTAR L	50x/0.55	8.0	X		C
PL FLUOTAR L	50x/0.55 BD	8.0	X	X	C
PL FLUOTAR L	100x/0.75	4.6	X		-
PL APO	50x/0.85 BD	0.34	X	X	C
PL APO	100x/0.90 BD	0.26	X	X	C
PL APO	150x/0.95	0.20	X		C
PL APO	150x/0.90 BD	0.25	X	X	C

INM300

Automated 300mm High-Resolution UV/DUV Review Microscope

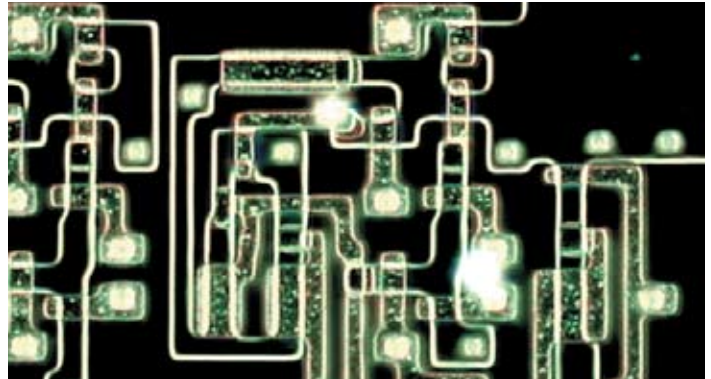
APPLICATIONS

Conventional contrasting methods

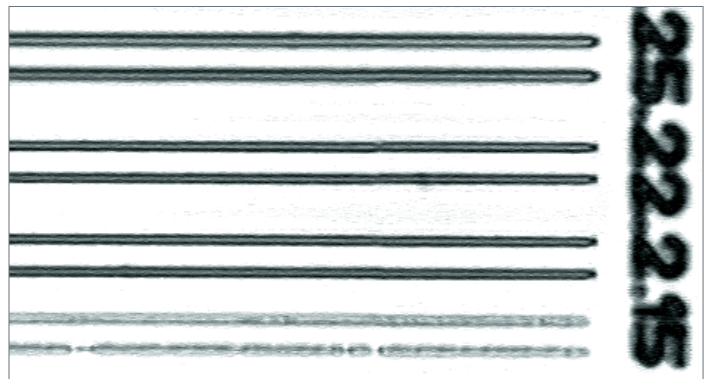
The fully automatic setting of the parameters is essential for easy handling of different contrasting methods. With the INM300 the use of various imaging modes is as easy as pushing a key, as the microscope takes over responsibility to set the required modes with the optimum contrast to achieve reliable results. Typical applications for brightfield (BF) is the inspection of shapes of structures, layers and etch quality, while darkfield (DF) provides the assessment of edge roughness and surface impurities. Differential interference contrast (DIC) method reveals changes in topography or refractive index as differences in brightness or color depending on how the system is adjusted. The build-in motorized fourfold contrast turret allows the selection of four of the following contrasting methods—Brightfield, Darkfield, DIC, UV, DUV and DUV WI — which may be used at the same time without any compromise.

Ultra-Violet imaging

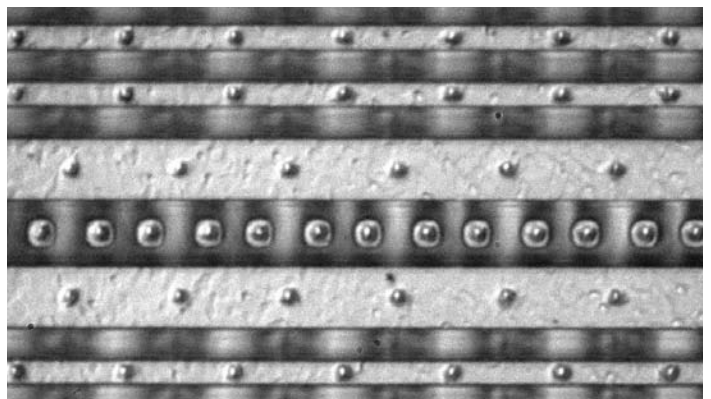
The INM300 satisfies advanced chip manufacturing by offering ultra-violet (365 nm) and deep ultra-violet (248 nm) optics. Using highest numerical apertures, and dry (non-immersion) objectives, the non-destructive, contamination-free inspection of feature sizes as small as 120 nm (UV) and 80 nm (DUV) is now possible with this advanced light microscope. With the tool's ultra-violet options, the UV-imaging is easy to handle as any other conventional contrasting method, with only a single keystroke required to automatically switch over to the UV or DUV image. A further milestone in the development of imaging technology is the introduction of the DUV Water Immersion (DUV WI) contrasting method, allowing inspection of structures as small as 60 nm. The DUV WI method can be upgraded on any DUV version of the INM300. The INM300 is currently the most cost effective system for the visualization of submicron structures.



Darkfield image taken with HC PL FL 50x/0.85



Resist structures in UV-mode 150x/0.90 365 nm



DUV image

AUTOMATION

Highest automation degree focuses your attention on the inspection task

The KLA-Tencor INM300 features the highest degree of automation in optical microscopy, with a multi-functional operating panel that helps you execute your inspection task. It responds reliably to commands and guarantees faster and simpler operation, allowing the user to concentrate rather on the inspection task than on controlling the instrument. Also, with the INM300's far-reaching arm movements of the sample stage, complex multi-step selection of contrasting methods is a thing of the past. In order to create an optimum image, the INM300 allows automatic fast and reliable selection of all imaging modes as well as precise auto focusing of the sample, illumination intensity control, optimum setting of the field and aperture diaphragm and proper selection of the magnification changer.

Higher operation flexibility with operating panel and built-in function keys

The separate operating panel is the control and information center of the INM300, and it displays the state of the microscope, the auto-focus, the Z-drive, the objective revolver, the aperture diaphragm and the lamp intensity. The operating panel is used to teach and program the instrument. Furthermore, direct access to all motorized and automatic functions is possible via this panel, or through a PC with proprietary software. In the field of semiconductor inspection, some operators need access to all microscope functions while others use the microscope as a pre-programmed tool. If pre-programmed, the INM's operating panel can be taken away and the microscope can be controlled via the built-in function keys. Due to the maximum degree of automation, the INM300 produces always reproducible results even if used by different operators.

Motorized focus drive

The focusing speed is adapted to the magnification of the objective in use. Ultra-fine focusing is achieved with a high magnification objective (e.g., PL APO 150x/0.95), whereas focusing a low magnification (e.g., PL FL 2.5x/0.07) objective is relatively fast. An integrated transducer system (resolution 18 nm) enables the user to store the focus for each objective. With the high precise motorized focus drive, the INM300 can be used as a semi auto-focus system.



Operating panel



Build-in function keys



Auto-focusing for all imaging modes

Safe and reliable focusing of the image is fundamental for reliable inspection results especially when scanning stages are used. After sample exchange, just one keystroke is enough to get the right focal plane and retain it even if the stage is moving at maximum speed. The auto-focus works in all illumination modes. Extremely critical objects such as polysilicon, nitride or glass – down to a minimum sample reflectivity of 1% – can be focused automatically, too. The operator has at any time the possibility to override the auto-focus manually, if required, with the drive knob or optional trackball. The z-height is displayed on the Vistec INM300 operating panel and can also be used for simple height measurements.

Safety of samples

KLA-Tencor's INM300 allows easy focusing without risk even with minimal working distance objectives. The focus drive has a flexible high-precision mechanical upper limit sensor. Thus, easily set, it prevents contact between wafer and objective, eliminating the risk of wafer damage.

INM300

Automated 300mm High-Resolution UV/DUV Review Microscope

SYSTEM FEATURES

Concentrated fatigue-free work

A perfect combination of high automation degree together with intelligent arrangement of the operational elements creates a user-friendly and ergonomic operating environment. The layout of the controls is matched to industry standard specifications for ergonomically designed workstations. The multi-functional operating panel ensures fast and easy operation and minimizes operator faults. Alternatively, with the left hand you have access to all relevant microscope functions (focus override, contrast switchover, magnification selection and auto-focusing) while the right hand controls the stage movement. Using the ergonomic tubes, the operator can individually adjust the viewing position to obtain the optimum comfort posture. Both Ergotubes FSA-V and FSA-V Mot show upright, non-reversed images and

can be finely adjusted to individual viewing heights, interpupillary distances and vision defects. The superb image quality allows for long periods of concentration and ensures reliable results. The Ergotube FSA-V has a manually switchable beam splitter, which allows for the light splitting between the TV-exit and the eyepieces. The motorized version FSA-V Mot serves for a fully automatic light splitting especially for the UV and DUV imaging modes. The HC PLAN 10x/25 large field eyepieces produce a sharply defined chrome-free image. The eyepieces are all suitable for viewing with and without eyeglasses. Eyecups are mounted on the eyepieces for viewers without eyeglasses to ensure exact coordination of the eye and microscope pupil positions for fatigue-free viewing.



Observation tube FSA-V



Eye pieces with variable viewing angle

Contamination-free

The INM300 conforms with Cleanroom Class 1, with a streamlined design and use of special coatings to guarantee an optimum air-flow. All motor driven parts are encapsulated, which ensures no contamination when in motion. The selection of the contrasting techniques, the magnification changer or the DIC-turret, are rotational functions instead of linear sliders. This allows for easier and faster operation and helps to avoid contamination due to much smoother movements. The entire reflected light path is a closed system not accessible from the outside. This guarantees contamination-free operation and keeps the optics clean. The transparent contamination shield prevents particles possibly generated by the operators hands and breath from contaminating the sample.

Illumination Methods

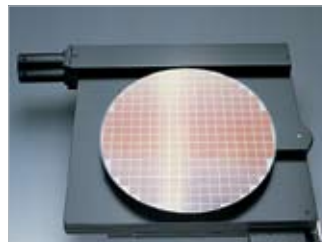
The INM300 is prepared for incident and (optional) transmitted light application. The built-in power supply is switchable to provide either illumination. The whole illumination system has been optimized to the latest criteria in terms of homogeneity, intensity and chromatic correction, providing the basis for powerful and color-neutral object illumination.

Rigid construction for vibration-free imaging at highest magnifications

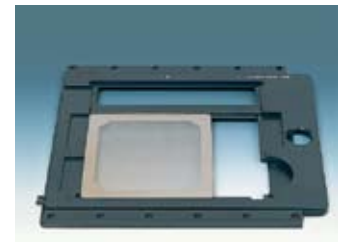
Ultra-high magnifications like those offered with Ultra-violet imaging technology need a stable and rigid microscope frame. The mechanical design of the INM300 was developed to fulfill even highest inspection and measurement requirements up to 300 mm sample sizes.

Sample Stages

The INM300 can be equipped with manual or scanning stages. There are two manual stages: a 300 mm x/y stage and a general purpose 200 mm x 200 mm stage available. High precision programmed inspection is guaranteed with Leica scanning stages (200 mm and 300 mm) for high throughput and fast and reproducible results expected in today's chip production. The 200 mm and 300 mm scanning stages are ideal for all standard inspection and review applications due to flexible travel speed, high resolution and excellent reproducibility. The vacuum mask- or rotatable wafer holders for both, manual and scanning stages ensure easy and safe sample insertion.



300mm stage with wafer holder



Variable mask holder

Software packages

Inspection and review applications are key constituents for an optimum yield management and reliable performance of the wafer production process. The inspection module allows reproducible scanning sequences for automatic inspection, whereas the review module guarantees redetection and classification of defects. Various software features based on the VISCON software can also be used with the INM300 stand alone microscope. Thus, it serves you with maximum flexibility and offers a solution to all your inspection problems. The INM300 is also capable of LAN-interfacing. Image capturing and archiving modules permit easy storage of defect images.

Digital image documentation

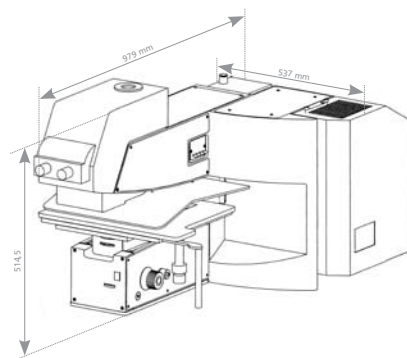
Digital image documentation and archiving is gaining more and more significance in semiconductor microscopy for several reasons; video technology offers brilliant display quality, favors a relaxed working position at the monitor; but most significantly, it creates completely new possibilities when combined with electronic media, enabling video images to be stored and managed in digital picture archives. The INM300 has been designed specifically with those applications in mind. Different TV-Adapters from 0.35x to 2.4x with C-Mount and ENG-Mount are available to serve various documentation needs. The special Dual Port TV-Adapter can simultaneously take two cameras at a time: The UV- or DUV-sensitive b&w camera and a color camera. As various picture archives can be networked, you also have fast and trouble free access to pictures taken in production in different locations or parts of the world.



Visible light camera on a C-mount



Visible light and UV camera on a double TV exit



SPECIFICATIONS

Illumination	Reflected/transmitted light
Imaging modes	Brightfield, Darkfield, DIC DUV WI, UV (365 nm) DUV (248 nm)
Light sources	12V/100W halogen (RL), Optional 12V/20W (TL) Stabilized power supply built in HG 100W, stabilized, for UV and DUV (optional)
Automated functions	Aperture selection Image mode selection BF, DF, DIC, UV, DUV Light intensity adjustment Sextuple objective nosepiece Auto-focus (optional) Motorized-Z-drive (resolution 18 nm) Magnification changer Beamsplitter in tube (FSA-V Mot)
Optics	High performance HC optics for all imaging modes Field of view 25 mm special objectives with extra long working distance
Magnification range	1.6x – 150x
Objective nosepiece	Six place objective turret, motorized
Stages	Fast positioning manual stage 200 mm + 300 mm Scanning stage 200 mm x 200 mm for reflected and transmitted light Scanning stage 300 mm for reflected light only
Observation tubes	Ergonomic tube FSA-V (incluable 0 – 35 degrees) Ergonomic tube FSA-V Mot (incluable 0 – 35 degrees) Motorized beamsplitter
Focusing	Manual focus through motor drive – focus action is magnification-dependent (resolution 18 nm) Semi-automatic focusing through Z-position memory Fully automatic through the LFS focus system for all imaging modes Auto-focus repeatability $\leq 0.1 \mu\text{m}$ (objective 100x/0.90)
Filter module	Optional, 4 filters (diameter 32 mm)
Microscope dimensions	Width 537 mm Front-to-back 979 mm Height 514,5 mm
Electrical connections	220V/50Hz 110 V/60 Hz Power consumption 400VA max.
Accessories	Wafer and mask holders, camera adapters

KLA-TENCOR SERVICE and SUPPORT

Customer service is an integral part of KLA-Tencor's portfolio that enables our customers to accelerate yield. Our extensive customer service organization collaborates with customers worldwide through the life stages of their factory and tools to achieve the required productivity and performance at the lowest overall cost.

Automated 300mm High-Resolution UV/DUV Review Microscope

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