



Polarizing/Dispersion Microscope ECLIPSE LV100-UDM-POL/DS

Polarizing/Dispersion Microscope

ECLIPSE LV100-UDM-POL/DS



The LV100-UDM-POL/DS comes equipped with accessories for dispersion staining microscopy that aid in the identification of asbestos.

Asbestos is a natural silicate mineral found in rocks. The properties of asbestos, such as its refractive indices, birefringence, retardation, extinction angle, pleochroism and sign of elongation, can be measured with a polarizing microscope. These optical properties, characteristic to all types of material, help in the identification of asbestos. Nikon developed the LV100-UDM-POL/DS by equipping its high-performance polarizing microscope ECLIPSE LV100 POL with accessories that enable dispersion staining observations up to 400x.

Qualitative asbestos analysis The optical properties below can be determined by a polarizing microscope.

Birefringence

A birefringent crystalline material—such as asbestos—observed under crossed polars alternates four times between light and dark when rotated 360°. This change is due to the alternation between extinction position and diagonal position. In contrast, a single-refractive noncrystalline material, such as rock wool, remains dark when rotated.

Mixture of rock wool and chrysotile (40x objective)
Plain polarized light



Crossed polars, diagonal position



Crossed polars, extinction position



Rock wool (10x objective)
Plain polarized light



Crossed polars



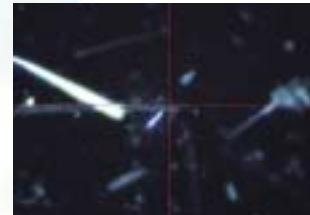
Extinction angle

Align the direction of elongation, or cleavage face, of a fiber with either the north-south or east-west crosshairs—vibration direction of the analyzer or polarizer—within the eyepiece. Under crossed polars, rotate the stage until the fiber appears dark (extinction). The rotation angle from the first position to the extinction position is the extinction angle.

Amosite
Plain polarized light, cleavage face aligned with the crosshair



Crossed polars, extinction angle measured



Sign of elongation

Align a fiber's long axis (direction of elongation) northwest to southeast so that the fiber is at a diagonal position of 45° to the vibration direction of the polarizer. Under crossed polars, insert a 530-nm sensitive tint plate in the optical path and observe the color changes of the fiber. When the interference color turns yellow or orange, the fiber is at the subtractive diagonal position. This means the direction of the elongation is parallel to the Z' vibration direction (slow axis) and therefore the fiber has a positive sign of elongation. When the interference color turns blue, the fiber is at the additive diagonal position. The direction of elongation is parallel to the X' vibration direction (fast axis), meaning the fiber has a negative sign of elongation.

Amosite
Positive: Subtractive diagonal position



Crocidolite
Negative: Additive diagonal position



Chrysotile
Positive: Subtractive diagonal position



(40x objective)

Refractive index (with plain polarized light)

The refractive index of a specimen can be obtained with the Becke line test (liquid immersion method). The difference between the refractive indices of the immersion liquid and the specimen is determined by observing the Becke line, which is a bright line visible along a specimen outline. Move down the stage and focus on the upper part of the specimen and the Becke line moves toward the medium—liquid or specimen—with the higher index ①. Focus on the lower part of a specimen by moving up the stage and the Becke line moves toward a medium with the lower index ②. The Becke line disappears when the refractive indices of the liquid and the specimen are equal. By finding the liquid in which the Becke line disappears in reference liquids with given refractive indices, an approximate refractive index of the specimen can be obtained.

Chrysotile and amosite (refraction index of the liquid n₀ = 1.605, 40x objective)



Birefringence magnitude and retardation (optical path difference)

The relation between birefringence and retardation is expressed as the formula below. Birefringence (n₂ - n₁) can be obtained by measuring retardation (R) and specimen thickness (d).

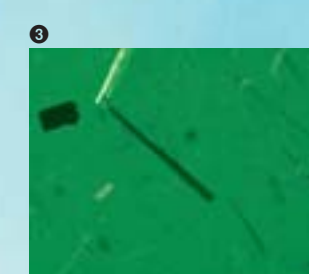
$$R = d (n_2 - n_1)$$

Retardation can be measured with the following method.

- Under crossed polars, rotate the stage until the fiber appears dark to determine the extinction position.
- Rotate the stage 45° from the extinction position to the diagonal position ①. Make sure that the interference color of the fiber turns the lower order color (yellow) when a test plate (530-nm sensitive tint plate) is inserted ②. If it turns the higher order color (blue), rotate the stage a further 90° so that it turns yellow and the fiber is at the subtractive diagonal position.
- Insert a green filter (IF546/12) into the light path. Remove the test plate and insert a Sénarmont compensator in its place. Rotate the analyzer until the fiber is at its darkest ③ and read the rotation angle (θ).
- Find retardation (R) using the formula below.

$$R = \lambda \times \theta / 180 \quad (\lambda: 546 \text{ nm, the wavelength used})$$

Amosite (40x objective)



Pleochroism

Specimen colors exhibited by absorption of light with different vibration directions are compared, when either the X' or Z' vibration direction of a fiber is aligned with the vibration direction of the polarizer (horizontal) and when the specimen is rotated 90°. This is observed with a plain polarized light (analyzer removed from the optical path).

Amosite



//: Parallel to vibration direction of polarizer



⊥: Orthogonal to vibration direction of polarizer

Crocidolite



//: Parallel to vibration direction of polarizer



⊥: Orthogonal to vibration direction of polarizer

Chrysotile



//: Parallel to vibration direction of polarizer



⊥: Orthogonal to vibration direction of polarizer

(40x objective)

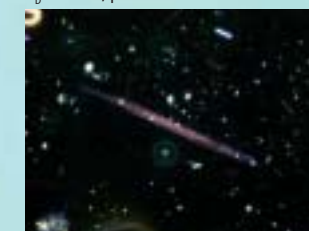
Dispersion colors

Rotate the condenser turret to select a phase ring (Ph1 or Ph2) for phase contrast observation and switch to a dispersion staining objective (40x) to observe characteristic dispersion colors of each asbestos type corresponding to the refraction index of the immersion liquid.

Chrysotile
n₀ = 1.550, red-violet to blue



Amosite
n₀ = 1.680, pink



Crocidolite
n₀ = 1.680, orange to red ocher





Ideal for image recording of asbestos

The 5.0-megapixel DS-Fi1-L2 digital camera for microscopes is easy to use. The camera control unit has a built-in high-definition 8.4-in. LCD monitor and allows observation and recording without a PC. The large monitor and high frame rate of the camera boost operability. A 100- μ m diameter concentric circle similar to an eyepiece graticule can be displayed for measurement. Two modes (red/blue) that allow imaging of asbestos with optimum color balance are available.

Combination example: DS-Fi1-L2 configured with ECLIPSE LV100-UDM-POL/DS

Specifications

Main body	Optical system	CFI60 infinity
	Illumination	New illuminator (brighter than 100 W)
		12 V-50 W halogen lamp (new LV-HL50W model); 12 V-50 W DC transformer built-in; Precentered lamphouse with rear mirror; Diascopic/episcopic illumination changeover switch; Fly-eye lens built-in; ND8, NCB11 filters detachable
Focusing	Coaxial coarse/fine focus knob; Focus stroke: 30 mm; Coarse: 14 mm per rotation; Fine: 0.1 mm per rotation; Minimum reading: in 1 μ m increments (left: coarse/fine, right: fine focus knob)	
Eyepiece	10x; F.O.V. 22; CM type with crosshair and micrometer scale, Eyepiece graticule for asbestos	
Eyepiece tube	P-TT Trinocular Tube for polarizing microscopy; With crosshair adjustment ring	
Polarizing intermediate tube	Analyzer detachable; Orthoscopic/Conoscopic observations switchable; With plate/compensator slot; Focusing and centering Bertrand lens	
Analyzer	360 ° rotary dial; Minimum reading angle 0.1 °	
Nosepiece	Reversed centering quintuple nosepiece (detachable); With DIN compensator slot	
Stage	High-precision circular graduated stage for polarizing microscope; Rotatable 360 ° horizontally; Can be fixed at a specific position; Graduated in 1 ° increments (0.1 ° readings with sub scale); 45 ° click stops	
	Attachable mechanical stage; Vernier 0.1 mm	
Condenser	Dedicated swing-out type P Achromat (NA 0.9) LV-CUD Universal Condenser Dry (for 10x, 40x phase contrast illumination)	
Polarizer	C-SP simple polarizer; one-touch swing-out type	
Objectives	Polarizing: CFI P Achromat 4x, 10x, 20x, 40x Dispersion: CFI Achromat 10xD, CFI Plan Fluor 40xDS	
Compensators	P-CL 1/4 λ & tint plate, quartz-wedge compensator or Sénarmont compensator can be inserted into polarizing intermediate tube slot	
Measuring filter	IF546/12 retardation filter (ϕ 45 mm)	
Power consumption	1.2 A/75 W	

Specifications and equipment are subject to change without any notice or obligation on the part of the manufacturer. November 2009 ©2009 NIKON CORPORATION



* Monitor images are simulated.

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