LAXCO
MICROSCOPES REDEFINED

LMC500 Series Upright Microscope

Version 1.0

User Manual

CONTENTS

BEFORE USE
OPERATION NOTICE

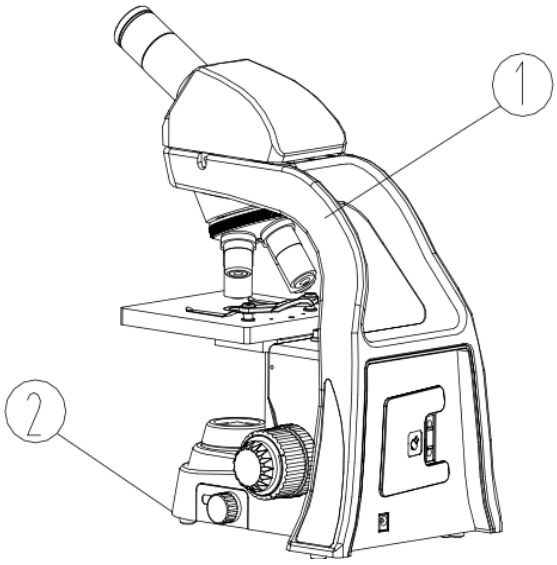


Fig. 1

1. As the microscope is a high precision instrument, always operate it with care, and avoid physical vibrations.
2. Do not expose the microscope in the sun directly, either not in the high temperature, damp, dust or acute shake. Make sure the worktable is flat and horizontal.
3. When moving the microscope, keep holding the rear cover hand clasp (1) and the front end of microscope body (2) with each hand. Handle with care. (See Fig. 1)

   * It will damage the microscope by holding the stage, focusing knob or head when moving.

4. Connect the microscope to the ground to avoid lightning strike.
5. For safety, make sure the power knob (1) is rotated counterclockwise to the minimum before replacing the bulb, and wait until the bulb and base cool down completely (see Fig. 2).

   * Bulb selected only: single 5050 LED

6. Wide voltage range is supported as 100~240V. Additional transformer is not necessary. Make sure the power supply voltage is in this range.
7. Use the special wire supplied by our company.

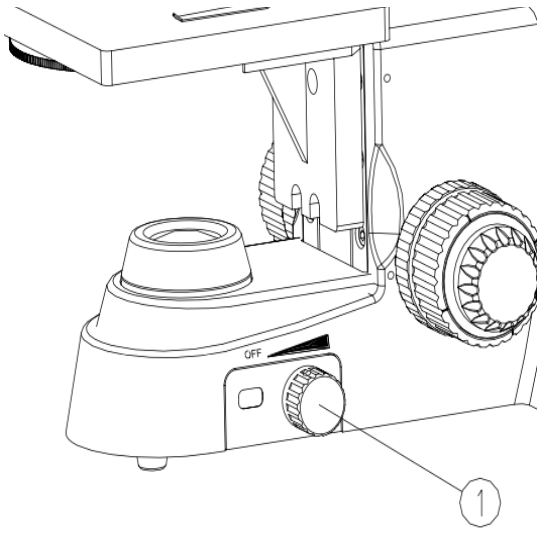
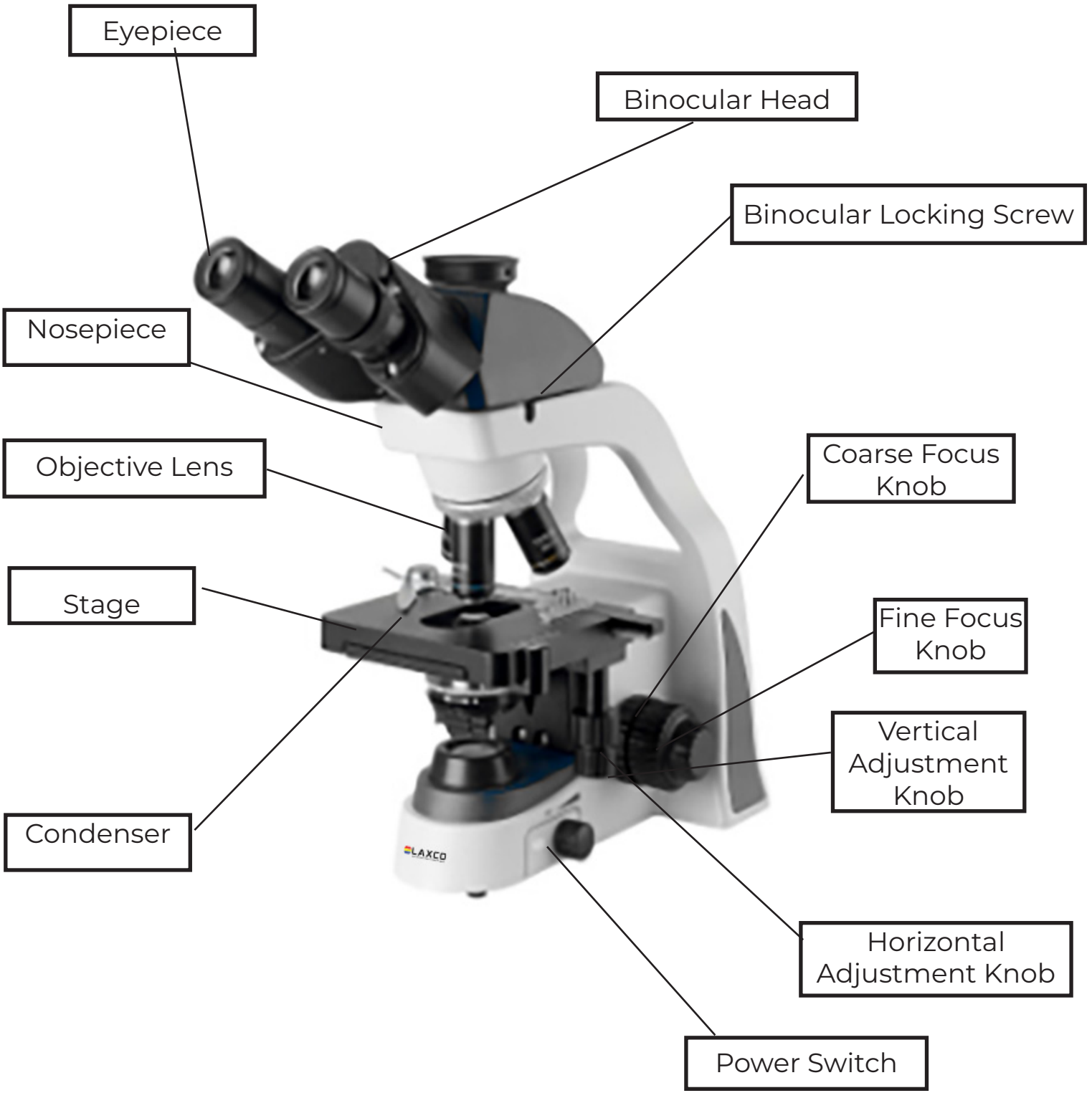


Fig. 2

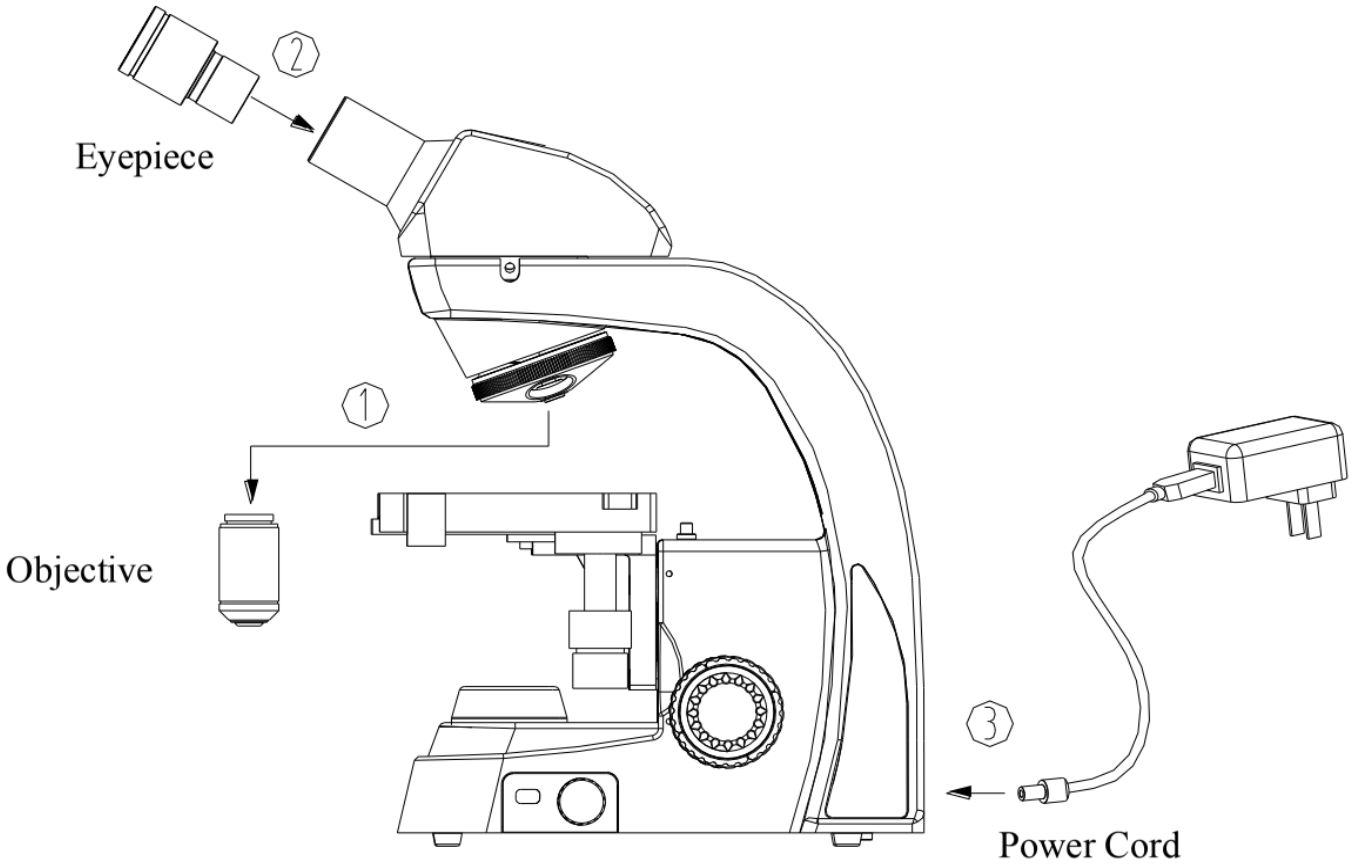
2. COMPONENTS



ASSEMBLING SCHEME

Following is the Assembling Scheme, and the numbers denote the assembling order.

- Before assembling, make sure there is no dust, dirt or other materials which will disturb it. Assemble carefully and do not scrap any part or touch the glass surface.



3. OPERATIONS

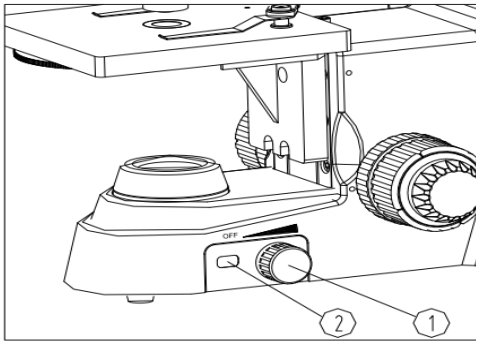


Fig.7

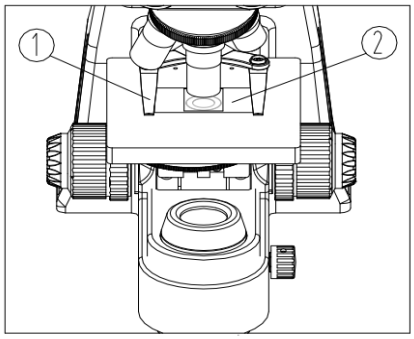


Fig.8

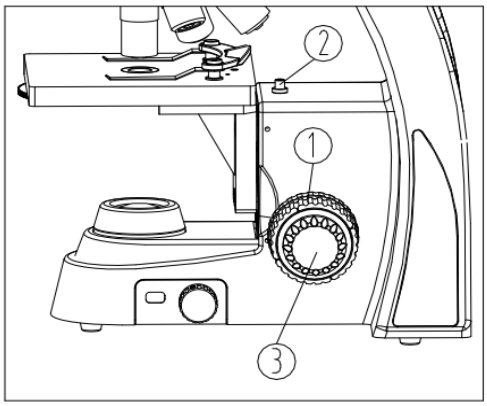


Fig.9

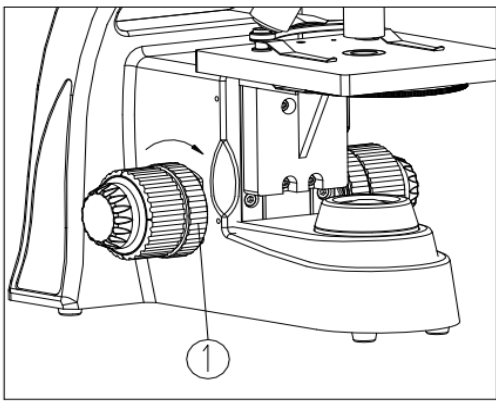


Fig.10

3-1 Set Illumination

1. Put through the power and adjust the light adjustment knob 1 until the illumination is comfortable for observation. Rotate the light adjustment knob in clockwise to raise the voltage and brightness. Rotate the light adjustment knob in counterclockwise to lower the voltage and brightness (see Fig.7).
2. Indicator light, light green when normal use, orange light when charging.

3-2 Place the Specimen Slide

Place the cover glass of slide 2 faced upwards and move the specimen to the center (aligned with the center of objective). And fix the coverslip by the slide-holder (see Fig.8).

3-3 Adjust the Focus

1. Move the objective 4X into the optical path.
2. Observe the right eyepiece with right eye, rotate the coarse focusing knob1 until the specimen outline appears in the view field (see Fig. 9).
3. Rotate the fine focusing knob3 for clear details.

- The position screw 2 can avoid the objective touching the clips.

3-4 Adjust the Focusing Tension

If the handle is very heavy when focusing or the specimen leaves the focus plane after focusing or the stage declines itself, please adjust the tension adjustment ring1 (see Fig. 10).

To tighten the focusing arm, rotate the tension adjustment ring 1 according to the arrowhead pointed; loosen it in the reverse direction.

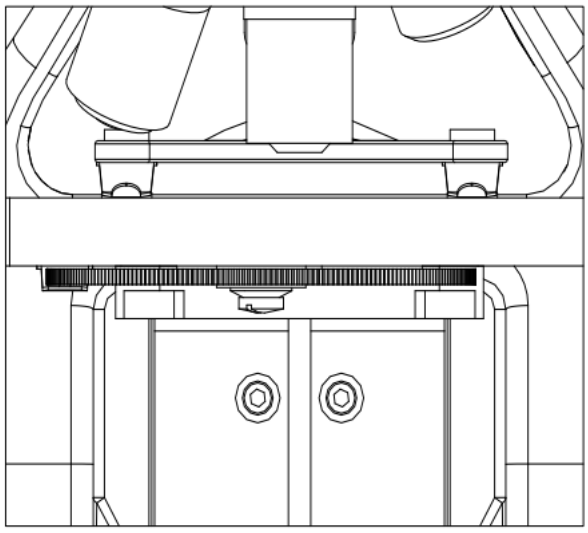


Fig.11

3-5 Aperture Diaphragm

1. The aperture diaphragm decides the numerical aperture of the illumination system. Only when the N.A. of illumination system is matching with the N.A. of the objective, it can obtain better resolution and contrast, and also increase the depth of field.
2. For the microscope with disc diaphragm, turn the diaphragm to select a aperture to get the back ground brightness suitable (see Fig. 11).

3-6 Use the Oil Objective (100X)

1. Use the 4X objective to focus the specimen.
2. Place a drop of oil 1 on the specimen observed (see Fig. 12).
3. Rotate the nosepiece counterclockwise and rotate the oil objective (100X) into the light path. Then use the fine focusing knob to focus.

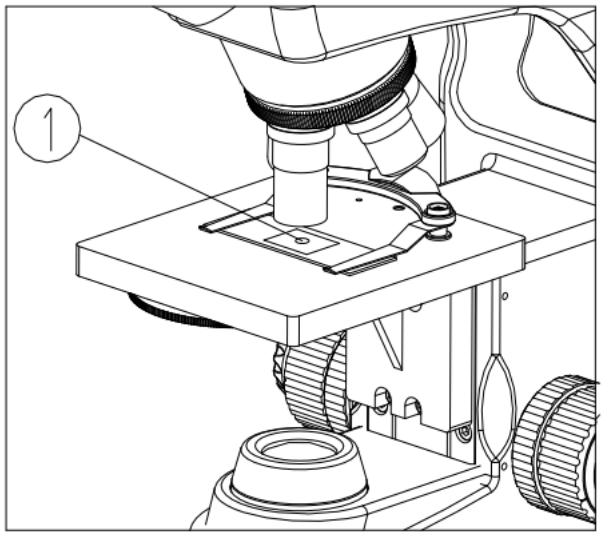


Fig.12

- Make sure there is no air bubble in the oil for fear affect the image.

  A. Move the eyepiece to examine the air bubble. Open the aperture diaphragm and field diaphragm fully and observe the edge of the objective from the tube (It seems round and bright).

  B. Rotate nosepiece slightly and swing the oil objective for some times to remove the air bubble.

4. After using, wipe the front lens with a tissue moistened with a small amount of 3:7 mixture of alcohol and ether or with dimethylbenzene. Wipe off the oil on the specimen.

- Don’t put another objective to the light path before the oil is wiped to avoid wetting the dry objective.

- Too much dimethylbenzene would dissolve the lens’s stickiness.

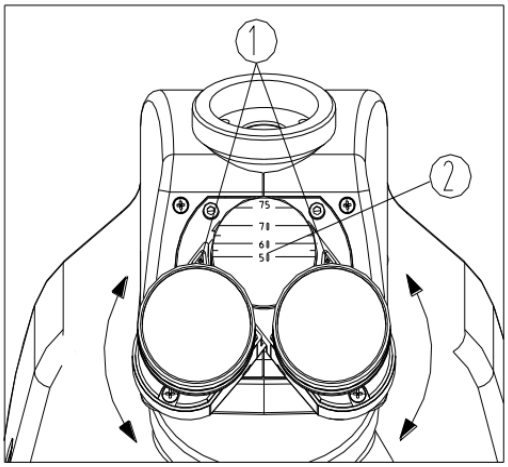


Fig.13

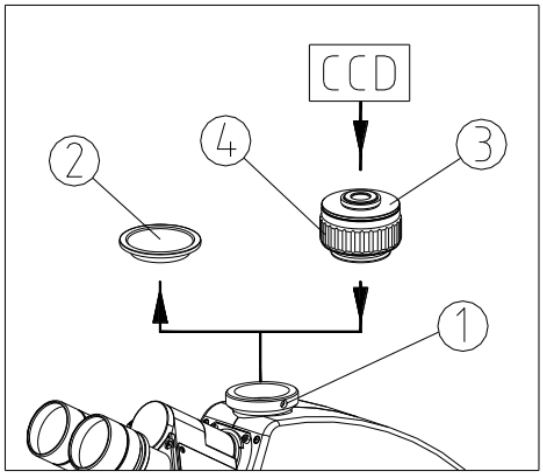


Fig.14

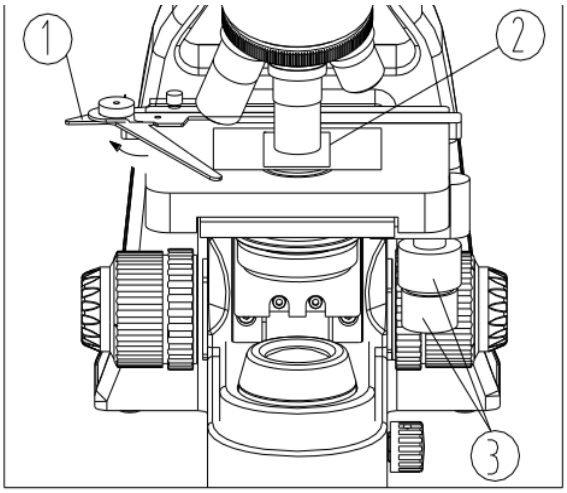


Fig.15

3-7 Use binocular head /trinocular head (Optional)

3-7-1 Adjust the Interpupillary Distance

When observe with two eyes, hold the base of the prism and rotate them around the axis until there is only one field of view.

"o" **(1)** on the eyepiece base points to the scale **(2)** of interpupillary indication, means the value of interpupillary distance (see Fig. 13).

Adjustable range:50~75mm.

- Remember your interpupillary distance for further operation.

3-7-2 Assembling and using of the TV Device

1. Loosen the lock screw1 of trinocular head, and take out the dust-cover2 (See Fig. 14).
2. Take down the two dust-covers of the TV adapter **3** . Insert the TV adapter into the trinocular head as shown in the figure and screw down the lock screw1.
4. Loosen the lock screw4 of the TV adapter. Take down the vidicon interface (C type) 5 from the TV adapter, and screw into the CCD or camera6. Then assemble the whole device on the TV adapter, and screw down the lock screw4.
5. For binocular observation, after the image is clear, observe the image of CCD. If the image is unclear, rotate the TV adapter3 for focusing until it is clear.

3-8 Use mechanical platforms (Optional)

3-8-1 Place the Specimen Slide

1. Push the wrench1 of the specimen holde backwards.
2. Place the cover glass of slide 2 faced upwards into the clip, loosen the wrench1 and clamp the slide (see Fig.15).
3. Rotate the X and Y-axis knob3 of the stage, and move the specimen to the center (aligned with the center of objective).

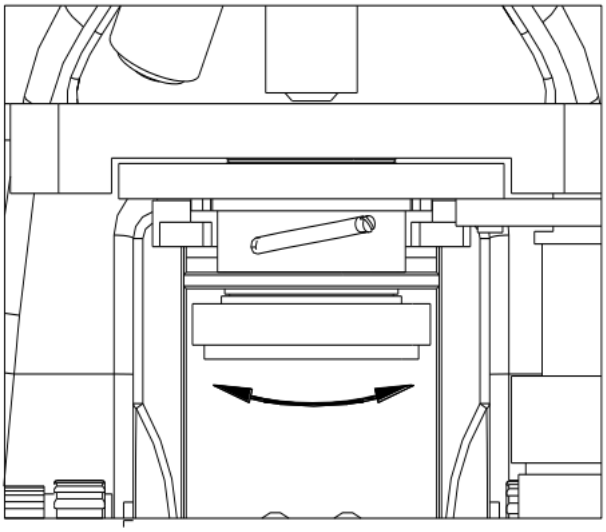


Fig.16

3-8-2 Aperture Diaphragm

1. The aperture diaphragm decides the numerical aperture of the illumination system. Only when the N.A. of illumination system is matching with the N.A. of the objective, it can obtain better resolution and contrast, and also increase the depth of field.
2. Turn the condenser clockwise or counterclock wise to change the height of the condenser (See Fig. 16).
3. Before installing the filter, rotate the condenser to the bottom and then open the filter holder.

    - Place the filter's rough side downward.

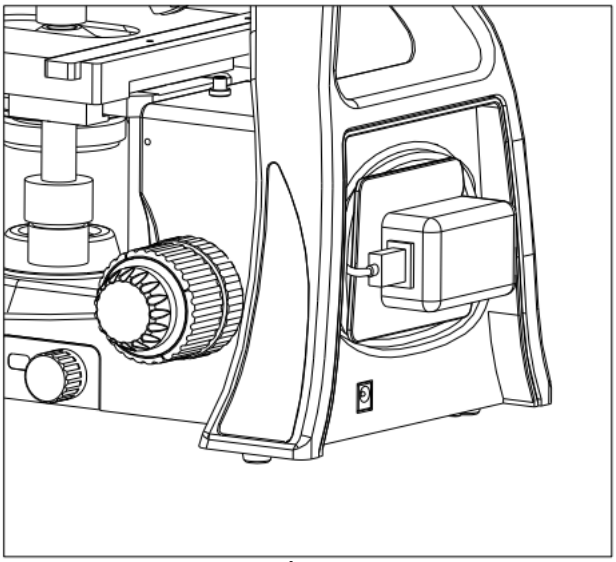


Fig.17

3-9 Store the Power Cord

When the microscope is not in use, the power cord can be wrapped around the rear cover, and the power charger can be plugged into the socket on the back of the microscope to avoid being lost. (See Fig. 17)

- Don't use strong force when the powercord is bended or twisted, otherwise it will be damaged.

- Use the special wire supplied by our company. If it's lost or damaged, choose one in the same specifications.

4. TROUBLESHOOTING

As the performance of microscope can't play fully due to unfamiliar operations, the table below can provide some solutions.

PROBLEM	CAUSE	SOLUTION
1. Optical Part		
(1) The LED light is bright, but it's dark in the field of view.	Field diaphragm is not large enough. Condenser is too low.	Enlarge the field diphragm. Adjust the position of condenser.
(2) The edge of the field of view is dark or not even.	The nosepiece is not in the right position. Stain or dust has accumulated on the lens such as condenser, objective, or eyepiece.	Turn the nosepiece into the right position. Clean the lens.
(3) Stain or dust is observed in the field of view.	Stains have accumulated on the specimen. Stains have accumulated on the lens.	Clean the specimen. Clean the lens.
(4) Unclear image	There's no cover glass on the specimen. The cover glass is not standard. The cover glass faces down. The immersion oil has accumulated on the dry objective. The immersion oil is not used for oil objective. Air bubble is in the immersion. Use wrong immersion oil. The aperture diaphragm is not opened correctly. Stain or dust has accumulated on the inlet lens of eyepiece. The condenser is too low.	Add the cover glass. Use a standard cover glass with thickness δ 0.17mm. Adjust it. Clean it thoroughly. Use immersion oil. Get rid of the air bubble. Use a correct one (cedar oil). Adjust the aperture diaphragm. Clean the lens. Adjust the condenser.
(5) One side of the field of view is dark or the image moves while focusing.	The specimen is not fixed. The nosepiece is not in the right position. Condenser centered incorrectly.	Fix the specimen. Turn the nosepiece into the right position. Center the condenser.

PROBLEM	CAUSE	SOLUTION
1. Optical Part		
(6) The eyes feel tired easily. The right field of view doesn't superpose with the left.	Interpupillary distance is wrong. Eyepieces for the left eye and right eye are different.	Adjust the interpupillary distance. Use the same eyepiece.
2. Mechanical Part		
(1) Cannot get the objective focused in high magnification.	The cover glass faces down. The cover glass is too thick.	Put the cover glass to face up. Use a standard cover glass with thickness δ 0.17mm.
(2) The objective touches the cover glass while turning the nosepiece from low to high magnification.	The cover glass faces down. The cover glass is not standard.	Put the cover glass to face up. Use a standard cover glass with thickness δ 0.17mm.
(3) Coarse focusing knob is too tight.	Tension knob is too tight.	Loosen it a little.
(4) Stage declines itself, cannot stay on the focal plane when observing.	Tension knob is too loose.	Tighten it a little.
(5) Coarse focusing knob can't rise.	The limit stop knob is locked.	Loosen the knob.
(6) Coarse focusing knob can't decline.	The base of the condenser is too low.	Raise the base.
(7) Cannot move the slide smoothly.	The slide is not fixed correctly. The movable specimen holder is not fixed properly.	Adjust it correctly. Adjust it correctly.
(8) The image moves obviously when touching the stage.	The stage is fastened incorrectly.	The stage is fastened incorrectly.
3. Electrical Part		
(1) The LED light does not work.	No power supply. The LED bulb is not installed correctly. The LED bulb is burnt out.	Check the connection of the power cable. Install it correctly. Replace it.
(2) The bulb burnt out very often.	A wrong bulb is used.	Replace it with a correct
(3) The illumination is not bright enough.	A wrong bulb is used. The use of light adjustment knob is wrong.	Replace it with a correct one. Adjust correctly.

5. REFERENCE

Glossary of Microscopy Terms

A

Abbe Condenser: A simple condenser comprised of two lenses; corrects for chromatic aberration.

Aberration: Term used to describe any inaccuracy in focusing of light; derived from physical limitations of lenses and optics.

Aberration, Chromatic: Inaccurate focusing of red, green and blue light.

Aberration, Spherical: Inaccurate focusing of light due to curvature of lens surface.

Achromat: A classification of microscope objectives with simpler lenses corrected for chromatic aberration by bringing red and blue light to the same point of focus.

Aplanatic Achromatic: A term describing the level of optical correction; typically used for condensers. This term indicates that the optical device is corrected to produce a flat field (aplanatic) as well as to accurately focus red, green, and blue light (achromatic).

B

Beam Splitter: An optical device that divides the incoming light beam. The beam can be divided either in terms of wavelength (for example, reflecting shorter wavelengths but transmitting longer wavelengths) or partial reflection (for example, from a partially mirrored surface or at the angled surface of a prism).

C

C-mount: A type of camera adapter typically used to connect video cameras to a microscope.

CCD: Type of video camera using electronic chips as the detector. CCD stands for charged-coupled device. Light falling on the chip creates an electrical charge at a specific location.

Centering Telescope: A special eyepiece fitted with a focusing mechanism and a longer-than-usual focal length, used for observing the back focal plane of an objective. The centering telescope can be used for aligning components for phase contrast.

Concave: Referring to a lens surface; bowing inward.

Condenser: The optical component located nearest the specimen but between the specimen and the light source; responsible for the placement and angle of light approaching the specimen.

Contrast: Visibility of an object or feature against its background.

Convex: Referring to the curve of a lens surface; bowing outward.

Coverslip Thickness: The thickness of a piece of glass used to protect and contain the sample on the slide. This value, usually 0.17 mm, is an optical requirement of the microscope, usually engraved on the barrel of the objective.

D

Depth of Field: The vertical distance in the sample through which features are simultaneously in focus. High numerical aperture objectives have a “shallow depth of field” and image only a very thin slice of information from the specimen.

Diffraction: Bending of light at the edges of features.

Diopter Setting: The focus of one eyepiece with respect to the other to compensate for differences in focus between the microscopist’s eyes. A critical setting to avoid eyestrain and headaches.

Glossary of Microscopy Terms

E

Eyepiece: The optical component that provides the second step in magnification.

Eyepoint: The back focal plane of the eyepiece; the location at which the cornea of the eye is placed so that the information from the microscope can be imaged on the retina of your eye.

Eyepoint,High: A special optical design in which the eyepoint is raised about 18 mm above the top surface to accommodate people who wear eyeglasses.

F

Field Aperture: The opening controlling the diameter of the field to be illuminated. The opening is controlled by an iris called a field iris.

Field Curvature: One of the optical distortions. When the center of the image is in focus and the edges fall out of focus, the field is said to "have curvature." When the image is in focus from the center to the edges, the field is said to be "flat." Plan objectives are corrected to produce flat fields.

Field Number: A number, usually engraved on an eyepiece, referring to the diameter of a baffle or raised ring inside the eyepiece. Determines the viewing field for the eyepiece. See also "Field of View."

Field of View (FOV): The actual diameter of the observable field in the sample; varies with the field number of the eyepiece, magnification of the objective and other intervening optics.

Filter: A device that changes either the intensity or the wavelength of light interacting with it.

Flatfield: See "Field Curvature."

Focal Length: Distance between the optical center of a lens and the point at which it will focus light coming from infinity.

Focal Plane: An imaginary, two-dimensional plane at right angles to the optic axis, comprised of an infinite number at focal points. Since an image can only be formed when light comes to a focus, the focal plane can be thought of as an imaginary "screen" on which the image is formed.

Focal Point: The point at which light comes to a focus to form an image. Lens systems have two major, on-axis focal points; one at the focal length, on the side of the lens from which the light is approaching (the front focal point), and the second at the focal length behind the lens (the back focal point). There are also an infinite number of focal points, both on-axis and
off-axis, determined by the relevant placement of the object and the curvature and composition of the lens system.

Field Aperture: The opening controlling the diameter of the field to be illuminated. The opening is controlled by an iris called a field iris.

Focus: The ability of a lens to converge light waves to a single point.

Focusing Eyepiece: An eyepiece fitted with a mechanism for adjusting the space between its lenses and therefore for adjusting focus.

Focusing Telescope: See "Centering Telescope."

FOV: See "Field of View."

Frame Grabber: An electronic device that captures an image digitally.

Glossary of Microscopy Terms

H

High Eyepoint: A design characteristic of eyepieces in which the back focal plane of the eyepiece is raised about 18 mm above the top of the eyepiece to accommodate microscopists who wear glasses.

I

Illumination, Axial: A contrast-enhancement technique for improving edge contrast. The condenser is closed most of the way, producing a highly coherent pencil of light.

Illumination, Phase Contrast: A contrast-enhancement technique used to image phase objects. Using a specifically designed annulus or ring placed at the front focal plane of the condenser, the zero-order background light is carefully placed into a special optical device (phase plate), mounted in the back focal plane of the objective. The phase plate has two functions: it reduces the intensity of the background light to approximately 15% of its original value and decreases its phase by one quarter of a wavelength. The light passing through a well-behaved phase-altering specimen (such as a cell) slows down by a quarter wave on that interaction, then another quarter-wave as it passes through the thickest part of the phase plate. As a result, when it meets the background light at the primary imaging plane, it is a half-wave out of step. The resulting destructive interference enhances contrast, making the object more visible against the background. Phase images often suffer from bright haloes at the edge of fine detail, partially due to the background light scattering when it hits the edge of the phase plate.

Image: The focusing of light in an organized fashion to reproduce information collected from the object. The more accurately the light is focused, the more accurately the object is represented in the image.

Image Analysis: Any type of measurement performed on the image, ranging from particle sizing and counting to determinations of motility or field-specific parameters such as orientation.

Immersion Medium: The material used between the uppermost surface of the sample and the objective. The immersion medium could be air, water, immersion oil, etc.

In Phase: A relationship between waves of light. When waves are “in phase,” the must be coherent (come from the same source, have the same wavelength, travel in the same direction, at the same point in time, vibrating in the same plane) and will reach their peak and fall to their trough at the same time. They are, literally, in step with each other. Phase annuli must be centered to produce in-phase images.

Infinity Corrected Optics: A special optical design involving at least two lenses in which the object is placed at the focal plane of the first lens, causing the imaging rays to emerge parallel to the optic axis or some principal ray. Since the emerging rays never focus to make an image, they are said to be carrying that information to “infinity.” The second lens then picks up the information as sets of parallel rays, and brings them into focus at its back focal plane. In a microscope, the objective is the first lens, the telan lens is the second.

Interpupillary Distance: The physical distance between centers of the pupils in the microscopist’s eyes; usually measured in millimeters.

Iris, Condenser: Iris controlling the angle at which light emerges from the condenser and approaches the sample; located at the front of the focal plane of the condenser.

Iris, Field: Iris controlling the size of the illuminated field in the sample. Usually located around the light port. Reducing the size of the field iris is one technique for controlling haze and glare.

Glossary of Microscopy Terms

K

Koehler Illumination: An approach to microscope alignment that separates the illuminating set planes from an imaging set. A major goal of this approach is to illuminate evenly the back focal plane of the objective for maximum resolution and evenly illuminated background.

L

Light, Polarized: Light in which the waves vibrate in only one direction, perpendicular to the direction of travel.

Long Working Distance (LWD): A term used for specially designed objectives and condensers providing more clearance between the surface near the sample and the sample itself. Especially useful for tissue culture and microtitre work.

M

Magnification: A mathematical relationship between the size of an image and the size of the original object. If the image is larger than the object, the term used is “magnification”; if the image is smaller than the object, the term used is “minification.”

Micron: A unit of length measurement. A micron (or micrometer) is 10-6 meters (0.000001 meters) or about 1/25,000 of an inch.

Microscope, Compound: A microscope providing magnification in two stages, the first through the objective and the second through the eyepiece.

Microscope, Inverted: A standard microscope configuration in which the sample is viewed from below. Especially useful when working with very thick samples such as tissue cultures and microtitre plates.

Microscope, Stereo: A standard microscope configuration based on two independent imaging paths, separated by approximately 10-12 degrees, resulting in a stereoscopic image characterized by great three-dimensionality and great depth of field. Frequently uses lower power (0.5 to 300x total magnification).

Microscope, Upright: A standard microscope configuration in which the sample sits face up on a stage, with the objectives mounted above it.

Microscopy: The art and science of making fine detail visible. The four major issues in microscopy today are magnification, resolution, contrast and measurement.

N

Neutral-DensityFilter: An amplitude object; an object that absorbs all colors of light equally.

Numerical Aperture (N.A.): A measure of information-collecting ability of a microscope optic. The numerical aperture is a product of the sine of half of the collecting angle and the refractive index of the immersion material. The greater the N.A., the better the resolving ability.

O

Object: The actual feature of interest or study under the microscope.

Objective: The optical component that gathers the information-bearing light from the specimen. Responsible for both the first step in magnification and for setting the limit of resolution for the entire system.

Optic Axis: The imaginary axis passing through an optical system, along which light travels.

Optics: Imaging components of the microscope. Examples include the objective, eyepiece and condenser.

Glossary of Microscopy Terms

P

Phase: A property of light in which waves are “in step” with each other. See also “In phase.”

Phase Contrast: A contrast-enhancement technique that detects phase objects. It uses a special ring, placed in the condenser to control location of the undiffracted light, and a matching phase plate, placed in the back focal plane of the objective. A wellbehaved phase sample will slow light by approximately one-quarter of a wavelength compared to the undiffracted background light. The phase plate is especially engineered to slow the diffracted light another quarter-wave. When the undiffracted light meets the diffracted light at the primary imaging plane to form the image, they will be out of step with each other by a half-wave, creating the condition of destructive interference and resulting in the darkening of the phase object and an improvement in contrast. Phase kits include a green filter (usually about 546 nm), which defines the wavelength for which the kit is optimized.

Photo Adapter: A special tube enabling cameras to be attached to the microscope.

Pixel: An electronic term used to describe the points of information used to map an image on a TV screen or computer monitor. Literally, a picture (“pix”) element (“el”). Each pixel carries at least the x,y location in the map and an intensity value (based on 256 gray levels).

Plan: An optical correction for objectives and condensers, indicating that the optical component has been corrected to produce a flat viewing field.

Primary Image: The first magnified image formed in the microscope.

Primary Image Plane: The location of the first magnified image formed by the objective.

R

Refraction: Bending of light as it passes, at an angle, across a boundary between materials of different refractive index; governed by Snell’s Law.

Refractive Index (n or ri): A number describing the relationship between the velocity of light in a material of interest compared to the velocity of light in a vacuum or air. The slower the velocity in the material, the higher the refractive index.

Resolution (R): The smallest distance by which two objects can be separated and still be imaged as two independent objects.

Reticle: A small disk with an engraved or photographic pattern such as a ruler or grid, placed in the eyepiece, in the primary image plane, so that the pattern will superimpose on the image of the specimen. Used for measurement (length, angle, counting, etc.).

S

Snell’s Law: The law governing refraction, relating to angles of approach and exit as light passes, at an angle, from one material to a second material of different refractive index. Snell’s Law states that light will bend toward the normal (an imaginary reference line drawn perpendicular to the surface at the point of entrance) as it passes from lower to higher refractive index.

Glossary of Microscopy Terms

T

Telan Lens: An auxiliary lens used in conjunction with an infinity corrected objective to bring light to a proper focus. In some systems, the telan lens will also correct the objective's residual chromatic aberration. See also "Tube lens."

Trinocular Port: A special eyepiece, usually narrower in design than conventional eyepieces, used in the photo tube of the microscope to project a real image to the film plane or detector of a camera system.

Tube Length, Fixed: An optical design approach in which the object is placed at some distance in front of the objective, causing the image to focus at a specific distance behind the objective. Typical distances for the mechanical tube length in these systems are either 160 mm or 170 mm.

Tube Length, Mechanical: The distance from the objective shoulder to the seat of the eyepiece. When replacing objectives, the mechanical tube lengths must match.

Tube Length, Optical: The distance between the back focal plane of the objective and the primary image plane.

Tube Lens: In infinity corrected optics, a lens that works along with the objective to form the image at the primary image plan. See also "Telan lens."

W

Wavelength: The distance along a wave from peak to peak or trough to trough. In microscopy, wavelength is often correlated to the color and energy of light.

White light: Light containing all three primary colors: red + green + blue.

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