Construct, Conduct & Comprehend Physics Experiments

LEOK-3-9 Build a Microscope and Determine Magnification Power

- *Complete set*
- *Cost effective solution*
- *Detailed instructional manual*
- *Easy alignment*

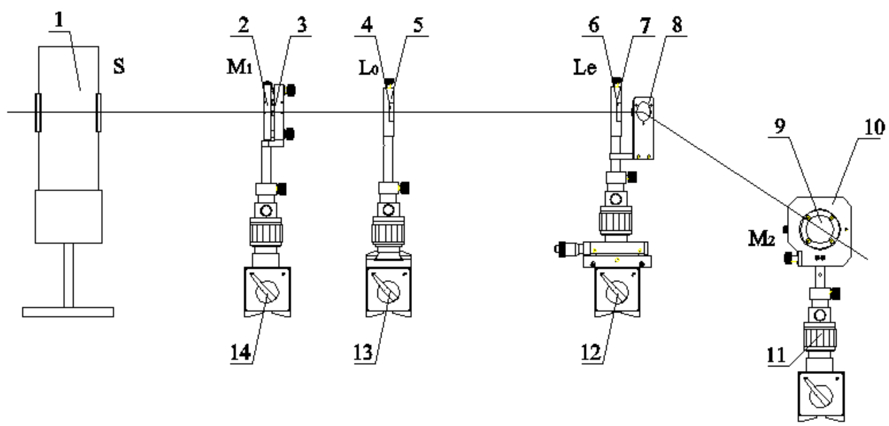

Figure 9-1 Schematic of experiment setup

1: Sodium Lamp *S* (LLE-2)
2: Reticle M_1 (1/10 mm)
3: Kinematic Holder (SZ-07)
4: Objective Lens Lo (f=45 mm)
5,6: Lens Holder (SZ-08)
7: Eyepiece Lens *Le* (f=29 mm)
8: 45° Glass Holder (SZ-45)
9: Millimetre Ruler M_2 (l = 30 mm)
10: Bi-prism Holder (SZ-41)
11, 14: Z-adjustable Stage (SZ-03)
12: Three-Axis Stage (SZ-01)
13: Two-Axis Stage (SZ-02)
Other: White light source (LLC-3) for illuminating the millimetre ruler

Theory

As shown in Figure 9-2**,** the optical system of a microscope employs an objective with a short focal length and a magnifying eyepiece. The magnification is achieved in two stages as shown in Figure 9-2. The microscope objective forms an enlarged image of the object in a position that is suitable for viewing through the eyepiece; the magnification through the objective is given by

$$y_2/y_1 = \Delta / f_o' \quad (9\text{-}1\text{-})$$

Generally speaking, the focal length of the eyepiece f_e' is much less than the distance of the image from the eyepiece *D*, (for normal sight, D is approximate 250 mm), so

$$y_3/y_2 \approx D/f_e' \quad (9\text{-}2)$$

Then we get the total magnification:

$$M = \frac{y_3}{y_1} = \frac{y_3}{y_2}\frac{y_2}{y_1} = \frac{D\Delta}{f_o' f_e'} \quad (9\text{-}3)$$

Where Δ is the distance between the focus of objective and the focus of eyepiece, f_o' is the focal length of objective and f_e' is that of eyepiece.

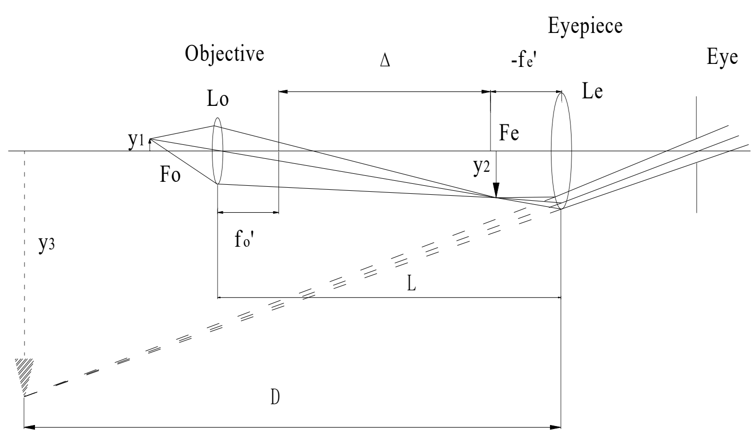

Figure 9-2 Schematic of microscope imaging

Experiment Procedures

1. Refer to Figures 9-1, align all components in same height;
2. Fix the spacing between *L*o and *L*e at 240 mm;
3. Move reticle plate M_1 back and forth, till a clear M_1 virtual image is observed behind *Le*;
4. Mount the 45° Glass Holder onto the post of the lens holder of the eyepiece lens *Le*, set the glass surface at 45° angle with respect to the optical axis; the glass is acting as a beam splitter (BS);
5. Put the millimetre ruler M_2 beside the Glass Holder (perpendicular to the main optical axis of the microscope system) and approximate 250 mm distance from the 45° glass; place the white light source (LLC-3) behind of the millimetre ruler to illuminate the ruler with proper intensity;
6. View behind the Glass by one eye, finely rotate the Glass holder to overlap the microscope virtual image from M_1 and the M_2 image from the glass reflection; note: if the brightness difference between the two images is too much, try to adjust the intensity of LLC-3;
7. Finely adjust M_1 to eliminate viewing difference between the two images;
8. Count the scale amount *a* in M_1 image included in the range of 30 mm of image $M_{2;}$
9. Calculate the measured magnification of the assembled microscope and its theoretical magnification:

Measured Magnification: $M = \frac{30\times10}{a}$.

Theoretical Magnification: $M' = \frac{25\Delta}{f_o' f_e'}$,

where, $\Delta = D - (f_o' + f_e')$.

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