

TES08 - Fiber Cross-Sectioning Methods

Scope

This document addresses the methods for fiber cross-sectioning.

Safety Precautions

Universal precautions will be followed. Never look at the ultraviolet (UV) lamps while illuminated. To prevent exposure to the UV light only handle specimens under the UV lamp when the power source is turned off.

Materials Required

- Glass microscope slides and cover slips
- 3.5 mil or 4.0 mil thick polyethylene sheets cut into ½”x ½” squares
- Hot plate
- Razor blades
- Forceps
- Stereobinocular microscope, magnification range from 0.5x to at least 40x
- Compound microscope with a minimum magnification range of 40x to 400x, with eyepiece reticle
- Norland Optical Adhesive
- Ultraviolet light source with maximum absorption within the range of 320-380 nanometers (nm) with peak sensitivity around 365 nm.
- Hardy microtome
- Joliff cross-sectioning plate
- Nail polish
- Acetone
- Needle threader

Procedure

Polyethylene Film Method

1. Place fiber/fibers between two small polyethylene squares.
2. Place the polyethylene/fiber sandwich between two glass microscope slides. Make sure to offset the microscope slides from one another so that they are easier to pry apart when removing the fiber sample.
3. Place the prepared sample on a hot plate and heat until the polyethylene melts.
4. Remove the sample from the hot plate with forceps and let it cool.
5. Remove the slides from the polyethylene/fiber sandwich.
6. Place the polyethylene/fiber sandwich under the stereobinocular microscope.
7. Cut away the excess polyethylene from one end of the fiber with a razor blade.
8. With a sharp razor blade, begin to cross-section the fiber in thin slices under the stereobinocular microscope.

9. Air-mount the cross-sections on a glass microscope slide.
10. Examine the cross-sections under a compound microscope.

Norland Optical Adhesive (type 65) Method

1. Mount fiber/fibers in a drop of Norland optical adhesive on a glass microscope slide. Do not place a cover slip over the fiber.
2. Place the slide under the UV light for 5 to 15 minutes to cure.
3. Remove the slide from the UV light.
4. Cut away the excess Norland from one end of the fiber with a razor blade.
5. With a sharp razor blade, begin to cross-section the fiber in thin slices under the stereobinocular microscope.
6. Air-mount the cross-sections on a glass microscope slide.
7. Examine the cross-sections under a compound microscope.

Joliff Plate Method - Yarn

1. Slide the needle threader through one of the holes in the Joliff cross-sectioning plate.
2. Thread the yarn through the needle threader.
3. Gently pull the fibers halfway into the hole on the plate.
4. Add a few drops of nail polish to the ends of the yarn protruding from the plate hole (top and bottom) and let dry.
5. With a sharp razor blade, slice the protruding ends of the fibers off so they are flush with the surface of the plate.
6. Examine the cross-sections of the fibers secured in the plate with a compound microscope.

Joliff Plate Method - Single Fiber

1. Pack the single fiber into a yarn of a different fiber type and color.
2. Slide the needle threader through one of the hole in the Joliff cross sectioning plate.
3. Thread the packed yarn through the needle threader.
4. Gently pull the packed yarn halfway into the hole on the plate.
5. Add a few drops of nail polish to the ends of the yarn protruding from the plate hole (top and bottom) and let dry.
6. With a sharp razor blade, slice the protruding ends of the fibers off so they are flush with the surface of the plate.
7. Examine the cross-sections of the fibers secured in the plate with a compound microscope.

Hardy Microtome Method

Setting up the Microtome

1. Remove the packing stage from the microtome base by unscrewing the two large tightening screws on the top of the stage.

2. Lower the plunger on the microtome base below the stage surface by turning the plunger dial counterclockwise.
3. Remove the packing stage and holding pin by unscrewing the smaller tightening screws.
4. Clean the plunger and sliding/packing stage with acetone.
5. Prepare and cross-section your sample.

Cross-sectioning a yarn

1. Prepare the microtome for cross-sectioning.
2. Pack the hole on the packing stage with your yarn by pulling one end of the yarn through the hole.
3. Slide the holding pin into place and tighten the small tightening screws, securing the yarn in the cross-sectioning tube.
4. With a sharp razor blade, slice off the excess fibers from the top and bottom of the packing stage.
5. Tighten the packing stage onto the microtome base with the large tightening screws.
6. Brush diluted nail polish over the top of the packed fibers and let dry.
7. Raise the plunger by turning the dial clockwise until the fiber begins to emerge through the sectioning tube.
8. Trim the excess fibers with a razor.
9. Raise the plunger slightly until the fibers begin to protrude from the sectioning tube.
10. Apply diluted nail polish to the top of the fibers and let dry.
11. Trim the excess nail polish with a razor.
12. Slice the fibers off with a sharp, straight-edged, razor blade.
13. Repeat steps 9 through 12 until you feel you have enough cross-sections to mount.
14. Place the fibers on a glass microscope slide and air-mount.
15. Examine the fiber cross-sections with a compound microscope.

Cross-sectioning a single fiber

1. Prepare the microtome for cross-sectioning.
2. Pack the single fiber into a yarn of a different fiber type and color.
3. Follow steps 2 through 15 of the Hardy Microtome cross-sectioning a yarn procedure.

References

- Hardy JT, "A Practical Laboratory Method of Making Thin Cross Sections of Fibers", U.S. Dept of Agriculture, Circulation No. 378, 1933.
- Greaves, P. H., and B. P. Savaille. "Special Preparation Techniques for Light Microscopy." *Microscopy of Textile Fibres*. Garland Science, 1995. 39-43.
- Palenik S.; Fizimons C., "Fiber Cross-Sections: Part I", *Microscope*, 38, 1990, 187-195.
- Palenik S.; Fizimons C., "Fiber Cross-Sections: Part II", *Microscope*, 38, 1990, 313-320.