

Preparing single fibers for Dynamic Contact Angle Analysis

Fiber wettability analysis is an active field of research that covers a wide range of materials including polymers, textiles, glass, carbon, wood, and fiberglass. Preparing fiber samples for analysis on a Thermo Scientific DCA (Dynamic Contact Angle) System is a procedure that is made simpler with the right tools, a little know-how, practice, and a modicum of patience. The method described in this communication applies primarily to fibers that are stiff enough so as not to require a weight for perpendicular immersion through the liquid interface. An alternative weighting technique is also available for fibers that are not rigid enough to penetrate the liquid without bending or curling at the interface. The weighting method for fibers will be the subject of a separate communication.

The right tools

Working with fibers is easy if you have the right tools. Many of the tools you will need are provided for you in the standard DCA accessory kit. These include:

- Ionizing Unit for static elimination
- Nichrome wire for mounting fibers
- Forceps for handling fibers

Other tools that will be useful for sample preparation and handling of fibers include:

- Standard light microscope (13.3 - 60x power) for fibers less than 50 microns in diameter
- Lighted magnifying glass for fibers greater than 50 microns in diameter
- Cyanoacrylate adhesive (i.e. Super-glue) to glue fiber sample to nichrome wire support
- Sharp scissors and/ or razorblade to cut fibers
- 10 ml beaker to minimize liquid volume
- Paperclips (4-5) to weight down nichrome wire for straightening
- 2 - #9 rubber stoppers for sample support stands
- 1.25 mm diameter or larger non-

- magnetic wire (6" - 8" in length) for nichrome wire support stand
- Small acrylic cutting board (4" x 4")
- Filter paper for viewing fibers under microscope

Preparing Nichrome Wire support

Attaching a fiber to the microbalance is generally best done by mounting a section of the fiber to a rigid support wire. Nichrome (nickel chromium alloy) wire is a good candidate for a support wire. This wire is provided in the standard DCA accessory kit in a 2 meter spool (0.25 mm in diameter). Start with a 4 - 5 inch piece, and use the forceps to form a 45 degree hook at both ends of the wire. To straighten the wire, hang one end to a paperclip suspended over the edge of a table. On the other end of the wire, hang 3 or 4 additional paperclips to provide enough weight to straighten the wire (Fig. 1). Strike a match and move it steadily across the length of the wire until it is straight. After the wire is straight, cut off the hook from one end with a razorblade and set aside.

A simple wire holder stand (Fig. 2) can be constructed by inserting one end of a sturdy 1.25 mm diameter or larger piece of non-magnetic wire (bent at a 90° angle at the center) into a #9 or equivalent rubber stopper. Nichrome wire samples can then be conveniently hung by the hook on the horizontal section of the wire support stand. All nichrome wire support samples should be prepared in this manner, and for convenience all wire samples should be approximately the same length.

Mounting fiber sample

When preparing fiber samples, always work in a clean area that is isolated from contamination sources. Caution should always be used when handling fibers so as not to contaminate the fiber surface with dust of other contaminants. When handling

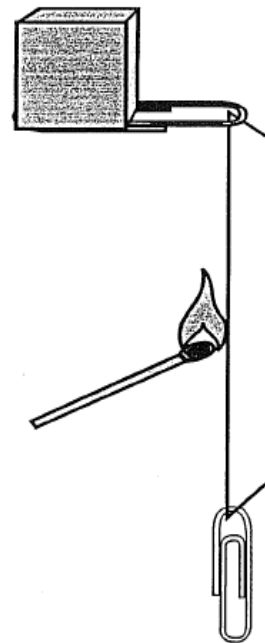


Fig. 1: Straightening Nichrome Wire

fibers, always use forceps and avoid contacting sections of fiber to be immersed in the probe liquid. Fiber samples should be placed on clean, dry filter paper during preparation and covered before and after preparation to prevent contamination.

Using a microscope at 13.3-60x power or a lighted magnifying glass, secure a single fiber (at least 10-15 mm in length) for analysis with the aid of forceps. Place a small bead of cyanoacrylate adhesive onto the bottom 5 mm of the nichrome wire support, and immediately bring one end of the fiber sample into contact with the wire support. Fiber sample must be oriented parallel to the wire support and overlap by at least 3 - 4 mm to ensure adequate adhesion. Allow sample to air dry for several minutes before proceeding further. Cut the final length of the fiber sample to provide at least 3 - 4 mm of scanning distance below the wire support contact point. Use a microscope or lighted magnifying glass to confirm that only one single fiber is in place



Fig.2: Wire Holder Stand

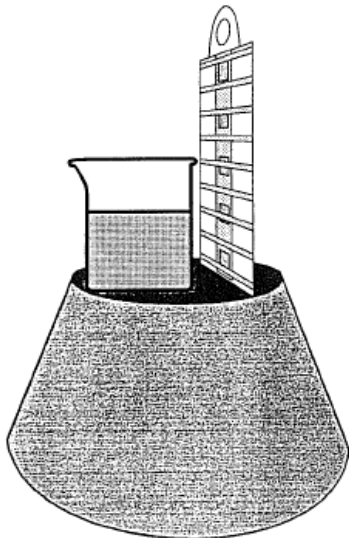


Fig.3: Ionizing Unit Stand

and, if necessary, use forceps to remove any stray fibers. Place sample onto in-line stirrup and inspect carefully for vertical positioning. If wire is not perpendicular to liquid surface, use forceps to adjust orientation of wire support until fiber sample is oriented at 90 degrees to the liquid interface.

Removing static from fiber sample

Before running a wettability scan, it is important to remove all static from the fiber sample by passing the ionizing unit around the perimeter of the fiber within 5 mm of the surface. If static is a big problem in the laboratory environment, use a second #9 rubber stopper to construct a stand for the ionizing unit (See Fig. 3). To make a mounting slot for the ionizing unit, use an exactor knife or razor blade to cut a 5 mm groove in the top of the stopper close to the outer edge of the stopper. Place one end of the ionizing unit into the slot, positioning the ionizing unit into a vertical orientation. Set the stopper onto the DCA stage and place a 10 ml beaker in close contact with the ionizing unit. This set-up will provide a convenient way to keep the fiber sample in close proximity with the ionizing source to control static.

Running a wettability scan

When running a wettability scan on a single fiber, slow stage speeds in the range of 2-24 microns per second (DCA motor #2A or #2) are recommended. This will permit the acquisition of more data points despite short scan lengths.

For more information concerning fiber wettability applications and the Thermo Scientific DCA RADIANT 322 Dynamic Contact Angle Analysis System, contact Thermo Fisher Scientific and ask to speak with an Applications Specialist.

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