

CLEAVING FUSED SILICA CAPILLARY TUBING

Synthetic fused silica capillary tubing continues to be a vital material in the separation sciences. In this application note, we discuss common tools and suggested methods used for routine cleaving of capillary tubing.

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Scientists around the world employ fused silica capillary tubing daily in a range of analytical applications, with the most common being GC, CE, Capillary LC, and MS. It is common for end users to cleave the capillary to its operational length, or cleave it periodically during use.

Cutting capillary tubing can be accomplished by a number of methods (1). The most common method, referred to as a standard cleave, can be accomplished with different cleaving tools, including diamond tip pencils, sapphire pens, and ceramic wafers. An elaborate device using a rotating diamond blade has limited use. A ceramic wafer, often referred to as a “cleaving stone” is the most efficient, cost effective tool. Using a Molex - Polymicro Technologies™ cleaving stone, this simple cleaving method yields a high quality end face finish and works well for many applications.

CLEAVING STONES

To successfully use a cleaving stone, one must understand how they are cut to size. Sheets of ceramic are manufactured to a thickness of ~1 mm. On one side, a series of pits are formed in a raster-like pattern to form a grid. The ceramic is then snapped along these grid lines to form 1" x 1" squares. The edges of the square where the pits were created is serrated, while the opposite edges will have a very sharp, clean morphology; see Figure 1. The differences between each side can be felt by sliding one's finger along each edge surface. To get the highest quality of cleave, the sharp, clean edge must be employed. The low quality, serrated edge should never be used.

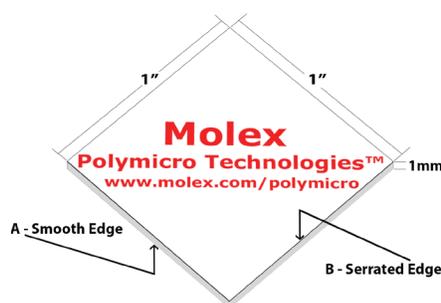


Figure 1: Cleaving Stone – Side A has a sharp, clean edge, while Side B has a rough, serrated-like edge. The logo is not aligned with either edge type; one must feel the edge to determine which edge to use.

CLEAVING THEORY

To cleave capillary, one must penetrate through the polyimide and impart a sub-micron to micron size defect into the outer glass surface. If the defect is too large, the cleave quality is compromised and excessive debris results. Once a defect has been generated, applying linear tension to the defect separates the capillary tubing. The most common error in cleaving is to bend the capillary tubing at the induced defect, which yields a low quality cleave, produces an uneven and jagged end finish (2), and generates unwanted glass debris. Excessive debris can lead to a brittle-back condition (3).

STANDARD CLEAVING PROCEDURE

1. Place the capillary tubing across the inside of your index finger, or on a clean, flat surface.
2. Holding the cleaving stone at approximately a 30° angle to the tubing, draw the edge of the cleaving stone across the tubing once; see Figure 2. The stroke of the cleaving stone should be similar to the motion of the pendulum on a grandfather clock. Apply just enough pressure to penetrate through the polyimide coating to generate the needed defect.
3. Pull the tubing axially until it breaks. If it won't break, the defect is too small. Repeat the above steps, applying slightly more force while drawing the cleaving stone across the tubing.
4. Once cleaved, inspect the end finish to ensure the cleave quality meets the application requirements.



Figure 2: Hold the cleaving stone at ~30° angle with respect to the capillary tubing.

REFERENCES

- (1) J. Macomber, P. Lui, and R. Acuna, LCGC North Am. “The Application Notebook, September” supplement, 66 (2009).
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- (3) J. Macomber, LCGC North Am. “The Application Notebook, June” supplement, 7, (2012).