

# POLYMICRO TECHNOLOGIES™ POLYIMIDE COATED CAPILLARY TUBING: A SUMMARY OF CUTTING TECHNOLOGIES



Joe Macomber, Rob Hintz, Todd Ewing, and Robert Acuña

Polyimide coated fused silica capillary tubing is a vital component in many separation science techniques. In this application note we discuss methods for cutting capillary tubing and show the results of different cutting technologies.

## INTRODUCTION

Fused silica capillary tubing's unique properties make it the material of choice for a number of analytical techniques, including GC, CE, Capillary LC, & CEC. Capillary is of growing importance in the area of Mass Flow Control and Fluid Metering. Its dimensional precision is unmatched for microfluidic interfacing.

Often the bulk capillary is delivered in long lengths and is subsequently cut by the end user. For products such as arrays, assemblies, and precision pieces, the capillary is often cut to specification by Polymicro. Regardless of who performs this operation, the methodology for cutting and the resulting end finish must be suitably matched to the application to achieve optimum product performance.<sup>1</sup> This note examines the four most prominent methods for cutting capillary.

## EXPERIMENTAL

The capillary used in this study was TSP025375 (Polymicro, Phoenix, AZ). Standard Cleaves were performed using a ceramic cleaving stone as described previously.<sup>2</sup> Precision Cleaved pieces were produced on a proprietary cleaving device that is optimized for 363µm OD capillary.

Saw Cut pieces were made by bowling cleaved segments into a 20mm tube with a proprietary polymer and then sawing on a Struers Accutom 50. Pieces were then debouled and cleaned with Acetone.

Laser Cut pieces were produced on a custom built, programmable laser station equipped with a CO<sub>2</sub> laser. A program specific to this capillary size was written to control part processing.

## RESULTS

Figure 1A shows a typical Standard Cleave, which has proven to be acceptable for a range of applications, including CE and CEC. Good cleaves leave few chips or cracks, and the polyimide should be flush with the capillary end face. There is often a slight angle on the end face and the surface can be uneven, as evident in the image.

Figure 1B displays a Precision Cleaved capillary. Note the flatness across the end-face when compared to Figure 1A. These types of low angle, high quality cleaves are of particular interest in Capillary LC connection lines and microfluidic interfacing, where unwanted chips, cracks, and angles can increase system dead volume and chromatographic band-broadening.

Figure 1C shows a typical Saw Cut end-face. Saw cutting is an efficient, bulk production methodology. However, chipping can occur, end-face surfaces have a matte finish, and glass debris can contaminate the i.d. filling the i.d. with a wax or polymer reduces chipping and introduction of debris, but must be removed after cutting; this can be a limiting issue depending on the i.d. and part length. Saw cut parts are often lapped and polished, significantly improving the part end-face. Saw cutting and then polishing is the best method for producing very short parts or parts with demanding length tolerances.

Figure 1D exhibits a Laser Cut capillary. Laser cutting is the method of choice when a very smooth, defect free end-face is required. This technique results in the removal of polyimide from the capillary o.d. surface. It should be noted that the i.d. will remain free of process debris.

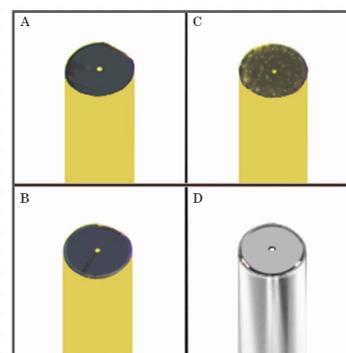


Figure 1: Images of TSP025375 cut by different methods. A) Standard Cleave, B) Precision Cleave, C) Saw Cut & D) Laser Cut.

## CONCLUSION

This note summarizes four commonly used techniques for cutting capillary. Application requirements must always be considered. For assistance with your specific application please contact a Polymicro Technical Sales Specialist.

## REFERENCES

- (1) J. Macomber and L. Begay, LCGC Application Notebook, Sept. 2003 p.72.
- (2) "Cleaving Procedure," The Book on the Technologies of Polymicro, Polymicro Technologies LLC Publication, p A-2, (2005).