

# FUSED SILICA CAPILLARY TUBING: A REVIEW OF CAPILLARY EXTERNAL COATINGS

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**Polyimide is the most commonly employed coating for capillary tubing used in the separation sciences. Although less prominent, other external coatings are available. In this application note we share some of our perspectives on coating options for fused silica capillary tubing.**

Synthetic fused silica capillary is used in a broad range of analytical instrumentation, including GC, CE, Capillary LC, MS, & CEC. The unique temperature and chemical resistance properties of polyimide make this capillary coating the ideal solution for many applications.

While polyimide is the industry standard for capillary coatings, Polymicro also offers a standard line of capillaries with UV-transparent coatings. Other specialty coatings are available on a custom basis, each with unique characteristics including chemical compatibility, optical transmission, operating temperature, and abrasion resistance. By selective incorporation of additives into the coating, capillary with unique functional properties can be produced, i.e. electrically conductive, opaque, etc. Table I provides an overview of various coating characteristics discussed herein.

## POLYIMIDE (TSP & TSG)

For analytical methods specifying temperatures up to 350°C, Polymicro's standard TSP capillary with its thin, durable, abrasion resistant coating is the ideal choice. Above 350°C, TSG polyimide is the preferred alternative. With thermal stability currently rated to 400°C, Polymicro's TSG formulation is ideal for many high temperature applications.

Polyimide demonstrates limited transmission below 450nm and broad fluorescence across the UV-Vis spectrum. (1) Laser removal of the polyimide to form

an on-column detection window is a routine practice in CE. (2) Polyimide demonstrates excellent chemical resistance, making it ideal for capillary LC. Swelling may occur after prolonged exposure to organic solvents, especially Acetonitrile. This effect can be nearly eliminated by additional baking of the polyimide prior to use. (3)

## UV-TRANSPARENT FLUOROPOLYMER (TSU)

TSU capillary has excellent deep-UV transmission and low background fluorescence. This capillary finds widespread use in monolithic column research, as it allows for efficient on-column photo-initiation during monolith formation. TSU has shown excellent resistance to most organic and inorganic solvents; the key exception is Fluorinert™, a commonly used cooling agent. TSU coating is thin and soft, so proper handling is important. (4)

## ACRYLATE (TSA)

The acrylate coating on TSA capillary is applied in thick layers, yielding outstanding abrasion resistance. At 125°C, it has a low maximum operating temperature. A proprietary treatment of TSA can create an opaque coating ideal for fluidic transfer of photo-sensitive compounds. Acrylate will swell quickly when placed into organic solvents (i.e. Acetone), allowing for easy removal. Acrylate has reasonable transmission in the visible range and exhibits lower fluorescence than polyimide.

## FLUORINATED ACRYLATE (TSH)

TSH coating is applied in thin layers, similar to TSU. The abrasion resistance compared to TSP and TSU is currently under evaluation. It has transmission down into the low 300nm range and fluorescence properties similar to TSA capillary.

## SILICONE (TSS)

Similar to Acrylate, Silicone can be applied in thick layers. Silicone exhibits high elongation and low adhesion which limits its use at high pressures and offers only moderate abrasion resistance. As a result, it is easily separated from silica tubing making it the coating of choice when mechanical stripping is required.

## CONCLUSION

This note discusses the key options available for external coatings of capillary tubing. Matching coating characteristics to your application requirement is important. Unique custom formulations can be produced to satisfy even the most demanding application. For your specific requirements please contact a Polymicro Technical Sales Specialist.

## REFERENCES

- (1) J. Macomber, R. Timmerman, P. Lemke, LCGC Application Notebook, June 2004, p.72
- (2) J. Macomber, K. Walker, LCGC Application Notebook, February 2006, p.66
- (3) F. Bauml, T. Welsch, Improvement of long term stability of polyimide coated fused silica capillaries used in CE and CEC. As presented at HPCE 2000, Saarbrücken Germany
- (4) J. Macomber, LCGC Application Notebook, June 2006

Fluorinert™ is a trademark of 3M.

Table I: Key Characteristics of Common Coatings

Coating Nomenclature	RI (@ 500nm)	T <sub>max</sub> (°C)	CT (µm)	Cut-off* (nm)
TSP	1.780	350	10-24	450
TSG	1.780	400	20-30	450
TSU	1.310	160	12-18	200
TSA	1.540	125	10-140	335
TSH	1.415	125	10-20	310
TSS	1.371	125	10-140	220

\*~10% Transmission through typical coating thickness (CT).

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