PUBLISHED ARTICLE

molex®

BRITTLEBACK IN POLYIMIDE COATED CAPILLARY TUBING

BY JOE MACOMBER | MOLEX, LLC.

Polyimide coated fused silica capillary tubing is widely used in the separation sciences. In some instances a condition called brittleback can appear in the tubing. Its causes and remedies are discussed.

Fused silica capillary tubing is produced in lengths ranging from a few hundred meters up to several kilometers. Gas Chromatography (GC) column manufacturers wind the tubing onto a cage, typically in lengths from 10 to 120m. Other users may trim off only a few meters to make a transfer line, retention gap or waveguide. Regardless of the use, the tubing must be cut or cleaved to length. In almost every instance, it is then connected to a fitting, valve, liner or similar device. On occasion, the user may find that the end of the tubing has become prone to breakage. This unwanted brittleness near the end, when caused by internal damage, is referred to as brittleback. This application note presents information on the causes of brittleback, techniques for minimizing its frequency and guidance for removing it once it is found.

BRITTLEBACK CAUSES

Capillary tubing develops brittleback because the internal surface has been mechanically damaged by debris. When the tubing is subsequently stressed by being bent or handled, it breaks. The most common debris sources are shards of glass from a poor cleave or an earlier break, metal particulates from fittings or valves, particulates/ precipitates from unfiltered solutions or particulates from dirty work or glassware surfaces. This debris is driven down the tubing by gases or liquids introduced into the tubing. The higher the head pressure and the larger the internal diameter, the further the debris can be driven down the tubing. Figure 1 is a good example of a brittleback event. End face analysis can be performed for verification and can sometimes clearly identify the debris source (1).

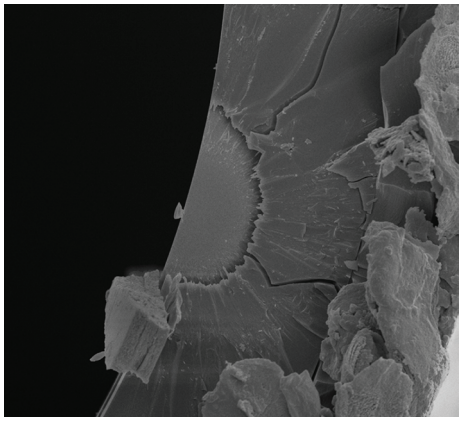

Figure 1: Brittleback Example - this glass debris induced break occurred ~35cm from the end of the tubing. The glass debris is less than 4µm in size and is typical of debris from a poor cleave.

MINIMIZING BRITTLEBACK

Brittleback is minimized by using techniques that reduce the generation and introduction of debris. Proper cleaving technique is vital and has been discussed previously (2). Cleaning of all valves, connectors and supply lines should be done as part of routine maintenance. Glassware used for tubing related processes should be cleaned and solutions adequately filtered (0.2µm recommended). Any surfaces that may contact the end face of the capillary should be kept free of debris (3). When introducing gases or liquids, ramp the head pressure up slowly, if possible, to minimize the initial linear velocity.

WHEN BRITTLEBACK OCCURS

Once brittleback develops, the first sign is an unwanted break, which only exacerbates the problem due to the additional glass debris generated. The best course of action is to remove and discard the damaged section. This is done by moving down the tubing and performing a good cleave. A starting point is 50cm, but Polymicro suggests moving 1m if possible. This is repeated as needed.

CONCLUSION

Brittleback is an unwanted condition when using capillary tubing. Proper techniques and good laboratory practices can minimize its occurrence.

REFERENCES

(1) J. Macomber, LCGC Application Notebook, 54 (Feb 2007).

(2) “Cleaving Procedure,” The Book on the Technologies of Polymicro, Polymicro Technologies Publication, p.A-2, (2011)

(3) J. Macomber and L. Begay, LCGC Application Notebook, 72 (Sept 2003).

Originally Published in LCGC, The APPLICATION NOTEBOOK (June 2012)

