Polyimide Removal from Silica Fibers or Tubes

The majority of the optical fiber and capillary sold by Polymicro is externally coated with polyimide to provide abrasion resistance and maintain product strength. Occasionally the need arises for the controlled removal of polyimide. A variety of methods can be employed to remove polyimide and care should be taken in selecting the appropriate technique. Some methods leave the glass surface relatively unaffected, while others embrittle the glass making the product extremely fragile and prone to breakage during handling. Listed below are a variety of removal methods and associated comments. In many cases Polymicro may have direct experience using the technique and a Polymicro sales technician can provide assistance.

Thermal Techniques

- **Open flame**: Matches and lighters are quick, easy, and effective at removing polyimide, but they tend to leave the glass surface brittle and are not recommended if strength of the final product is important.
- **Gas torch**: Oxygen/hydrogen flames do a good job of removing polyimide, leaving the final product strong. Care should be taken regarding the inherent dangers in using this type of torch and the potential for distortion of the filament from overheating does exist.
- **Gas torch**: Propane, etc. are often acceptable, but are not as good as the oxy/hydrogen flame. If the flame temperature is not high enough, the residual polyimide can be present.
- **Oven**: At temperatures >600°C the polyimide will carbonize and flake off. This generally takes 30 to 60 minutes, and can be expedited with higher temperature or the addition of oxygen. This method works well to remove large sections of polyimide. The finished product retains excellent strength after processing.
- **Electric coil heater**: Coiled NiChrome wire, or a NiChrome wire wrapped around a quartz insulating tube, makes a resistive coil heater capable of rapidly burning off the polyimide. The coil heater approach works, but one must be careful not to touch the glass to the wire or insulating tube. This will damage the glass surface, making the glass brittle. Residue is common and post-process cleaning is generally required.
- **Electric arc**: Plasma is effective at burning off the polyimide and leaves the glass strong. However, plasma removal can be challenging to control and overheating is difficult to avoid. In fact, this overheating can be useful; Polymicro uses an electric arc plasma technique to melt and seal all capillary ends prior to product release.
- **CO_2 Laser**: Removes the polyimide thermally, just as the above techniques. This method is excellent due to the clean heat source and the fine control over the hot zone. Distortion from overheating should be monitored.
- **Sulfuric acid***: When heated to 100-130°C, sulfuric acid (concentrated) removes the polyimide very rapidly. Multiple applications are recommended and the finished product should be rinsed with DI water after the polyimide is removed.
- **Strong bases***: Caustic solutions, such as Sodium hydroxide, will also attack the polyimide. Although these will remove polyimide, they generally etch the filament surface and are generally not recommended as a removal method.

**Caution: Proper laboratory safety practices should be followed when working with these types of chemical reagents.*

Laser

- **Excimer laser**: Ablates the polyimide without heat, providing a clean, undamaged silica surface. Polymicro uses this technique routinely, especially on products where a thermal char line is undesirable. This is the method of choice for volume production, but is not very practical for general lab use due to laser expenses.
- **CO_2 Laser**: See above discussion under Thermal Techniques.

Mechanical Stripping

- **Machining**: Removing the polyimide with a mechanical technique, such as an X-ACTO® knife, razor blade, or cutting tool, can work, but damage to the glass surface by the cutting tool will cause brittleness.
- **Wire strippers do not work.** Generally the polyimide is bonded to the glass surface. Wire strippers will damage the glass during stripping of the polyimide and breakage is almost certain.