

Cutting Glass Optical Ferrules Using Two Different Cutting Methods



SBT
Cutting and
Sectioning

1.0: Purpose

To precisely cut quartz optical ferrules near the bond interface in a controlled, precise manner with minimal surface chipping and fracture to the quartz. Maximum control of the cutting area, cutting surface, and parallelism are critical in cutting optical components such as these. Two cutting methods will be compared to characterize the best method for producing the best quality cuts for these optical components.

2.0: Experiments and Procedure

To characterize the correct usage of wheels, saws, and equipment setups several cuts were made on the optical components. Following each cut, the specimen were qualitatively evaluated based on surface finish, edge retention (i.e. the presence or lack of significant damage at the ferrule edge), and cutting quality. Shown below is a diagram of the optical ferrule itself.

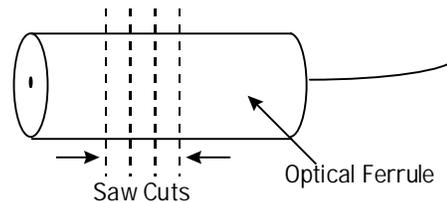


Figure 1: Illustration of the optical ferrule geometry and the manner in which the specimen was cut. The center of the ferrule contains a single optical fiber.

Model 650 Cuts

Several different wheel types were used to evaluate the cutting quality of different types of cutting wheels commonly used in today's sample preparation. The wheels evaluated were as follows:

1. SiC abrasive wheel; 4"
2. Diamond wheel, fine diamond size, high concentration (DWH 4121)
3. Diamond wheel, medium diamond size, high concentration (DWH 4122)
4. Diamond wheel, coarse diamond size, high concentration (DWH 4123)

Each wheel was used to make 2 cuts and each cut was subsequently evaluated to record the observed effects the cutting wheel had upon the specimen surface. The specimen was mounted to a graphite mounting block using low melting point wax. The wax was also used to cover the top surface of the specimen to prevent chipping when the cutting blade first comes into contact with the quartz optical ferrule.

Cutting parameters for all cuts made using the Model 650 were kept constant at the following conditions:

Load: 100 grams
Wheel speed: 300 rpm

Model 850 Cut

For wire saw cutting, different slurry grit types and sizes were used to characterize the best cutting media for these specimens. Various slurries were used to characterize the effects they had on the cutting quality of the specimen. The slurries used were as follows:

1. Al₂O₃ slurry, 22 micron abrasive size.
2. Silicon Carbide (SiC) slurry, 14 micron abrasive size.
3. Boron Carbide (BC) slurry, 22 micron particle size.
4. Diamond slurry, 15 micron particle size.

Each abrasive slurry was used to make two cuts each on the ferrule specimen. Following cutting, the specimens were removed and qualitatively evaluated to determine the best abrasive to use. The specimen was mounted in the same fashion as with the Model 650 saw, with a layer of wax on the surface protecting it from the initial contact with the wire blade. Cutting parameters were as follows:

Load: 100 grams
Wire: 0.010" stainless steel
Speed: 300 rpm
Slurry: Automatically applied to sample

3.0: Results

Following the cutting operations, each specimen was qualitatively evaluated based upon the criteria of surface finish, edge retention, and cutting quality. The table below outlines the observed characteristics of each cut type.

Cutting Instrument	Cutting Media	Description
Model 650	SiC abrasive cutting wheel	Good surface finish, small amount of chipping at the ferrule edges; no smearing across fiber center
Model 650	Diamond wheel: coarse diamond, high concentration	Fair surface finish, no chips seen at the edges; slight amount of smearing
Model 650	Diamond wheel: medium diamond, high concentration	Good surface finish, no chips seen at the edges; amount of smearing better than coarse diamond wheel
Model 650	Diamond wheel: fine diamond, high concentration	Excellent surface finish, no chipping at edges, very little smearing across fiber center.
Model 850	Al ₂ O ₃ slurry, 22 micron	Fair surface finish; no chipping at the edges, large degree of smearing across fiber center
Model 850	SiC slurry, 14 micron	Poor surface finish (not smooth), no chipping at edges; large amount of smearing
Model 850	BC slurry, 22 micron	Poor surface finish, no chipping at edges, smearing quite prevalent across surface
Model 850	Diamond slurry, 15 micron	Fair surface finish, no chipping at edges, small amount of smearing

When cutting with the Model 850 Wire Saw, the specimen surfaces produced appeared to be less crisp than the Model 650 cuts. However, both saws appear to give satisfactory results when it comes to cutting time, accuracy, and kerf loss. Both produced satisfactory results and would both work well for this application.

