NuUF Fibers for Ultrafast Applications

Introduction

The Coherent line of ultra-matched PLMA YDF and GDF fibers (NuUF) are designed specifically for high peak power applications. They provide increased cladding absorption and MFD to reduce the impact of nonlinearity. The YDFs provide high efficiency and beam quality when using matched GDFs. Table 1 lists the product offerings. More information can be found at *coherent.com or shop.coherent.com.*

Absorption and Cross-section

Table 1 also highlights the nominal cladding absorption specifications for the PLMA-UF YDFs. Depending on pump wavelength, pump architecture, and laser requirements these absorption values can be used to estimate gain fiber lengths. Typical YDF lengths range from 13 dB to 18 dB total pump absorption to enable good efficiency. Figure 1 shows a typical absorption cross-section for the PLMA-UF YDFs. This cross-sectional data is available upon request.

Cleaving

High quality cleaves are necessary to ensure successful splicing. Suggested cleavers are Fujikura CT-101 (or equivalent) for 14/125 fibers and Fujikura CT-106 (or equivalent) for 25/250 and 30/250 fibers. In order to optimize cleaves, tension should be reduced until the fiber cleave fails. The tension can then be increased just until cleaves are consistently achieved. At these settings, the fiber facet should be free from chips, blow-outs, or other defects. See Figure 2. The angle of the cleave should also be kept below 0.5 degrees to ensure optimal performance. Best practices suggest this angle measurement be performed with an interferometric facet inspection device, as the splicer estimate may not be sufficient to resolve low angles. A 3SAE NorthLabs ProView LD (or equivalent) is recommended. PLMA fibers should never be cut with scissors or looped and snapped to break them. They should always be scribed or cleaved (refer to our application note on cleaving PM fibers) End caps are the suggested method for fiber termination.

Active Fiber (YDF)	Peak Clad Absorption	Matched Passive Fiber (GDF)
1425270 PLMA-YDF-14/125-UF	16.6 dB/m @976nm	**1427334** PLMA-GDF-14/125-UF
1427335 PLMA-YDF-25/250-UF	11.9dB/m @976nm	**1427254** PLMA-GDF-25/250-UF
1430933 PLMA-YDF-30/250-UF	17 dB/m @976nm	**1437945** PLMA-GDF-30/250-UF

Table 1: Matched PLMA-UF fibers and nominal absorption.

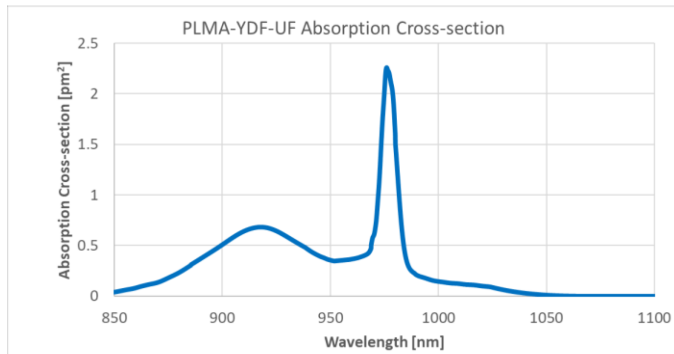

Figure 1: PLMA-YDF-UF absorption cross-section.

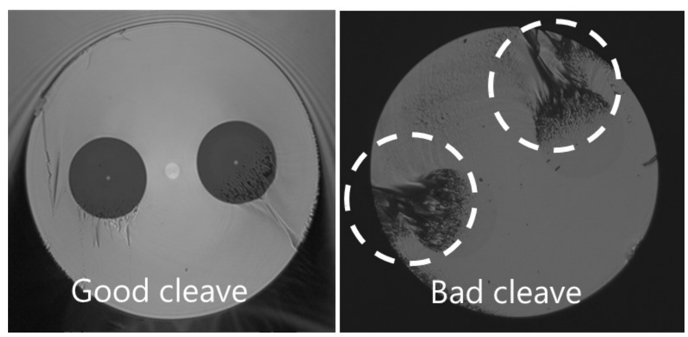

Figure 2: Example of good cleave (left) and bad cleave (right).

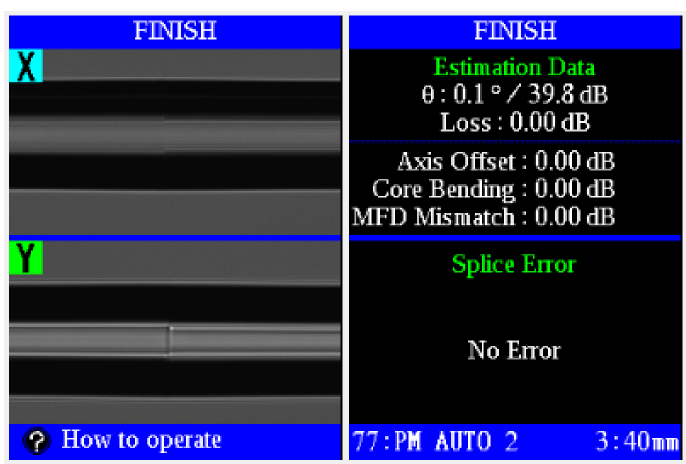

Figure 3: Optimized splice with minimal heat distortion and low loss.

Splicing

Proper splice optimization will ensure high PER, efficiency, and beam quality. Splices should not display voids, 'bubbles', nor gaps at the fiber interfaces. The fibers also should not appear distorted, tilted, or expanded. These characteristics commonly indicate the splice recipe has excessive heat. See Figure 3. To achieve optimized splices, reduce arc power and/or time until the fibers fuse but are mechanically weak – failing the splicer built-in proof-test. Then increase arc power and/or time until the splice consistently passes the built-in proof-test. Recommended splicer for all PLMA-UF fibers is Fujikura FSM-100P (or equivalent).

Beam Quality and Efficiency

PLMA-UF fibers are designed to provide large MFD's with good beam quality when the matched YDFs and GDFs are integrated with proper splice optimization. Table 2 shows measured beam quality with these fibers and suggests coiling diameters to provide a balance between beam quality and efficiency. Figure 4 shows a typical M^2 trace verifying beam quality. The low M^2 values achieved highlight the MFD matching between paired YDFs and GDFs that ensures good PER and low splice loss for high-efficiency systems.

PLMA-YDF-14/125-UF Dispersion

Relative Group Delay (RGD) and Dispersion in the wavelength range of Yb gain are shown in Figure 5. Nominal values near the Yb gain peak are 5000 ps/km for RGD and -45 ps/nm-km for Dispersion. The zero-dispersion wavelength is near 1270 nm. Due to their matched waveguides and material dispersion dominated by fused silica, the GDF dispersion will be similar to the YDF. These values of dispersion do not include the impact of gain which can vary from system to system. Therefore, this data should be used as a starting point for fs laser systems with PLMA-UF 14/125 fibers. Fine-tuning may be required based upon unique system requirements. PLMA-YDF-14/125-UF dispersion data is available upon request.

Contact

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Active Fiber (YDF)	Passive Fiber (GDF)	Coil Diameter	Measured M^2 (GDF-YDF-GDF)
PLMA-YDF-14/125	PLMA-GDF-14/125	100 mm	1.07
PLMA-YDF-25/250	PLMA-GDF-25/250	75 mm	1.15
PLMA-YDF-30/250	PLMA-GDF-30/250	75 mm	1.31

Table 2: Suggested coil diameters and actual measured beam quality.

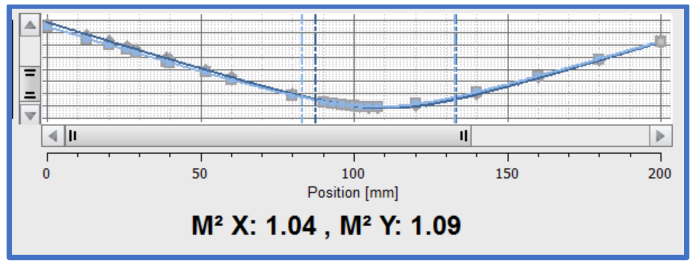

Figure 2: PLMA-YDF-14/125-UF M^2.

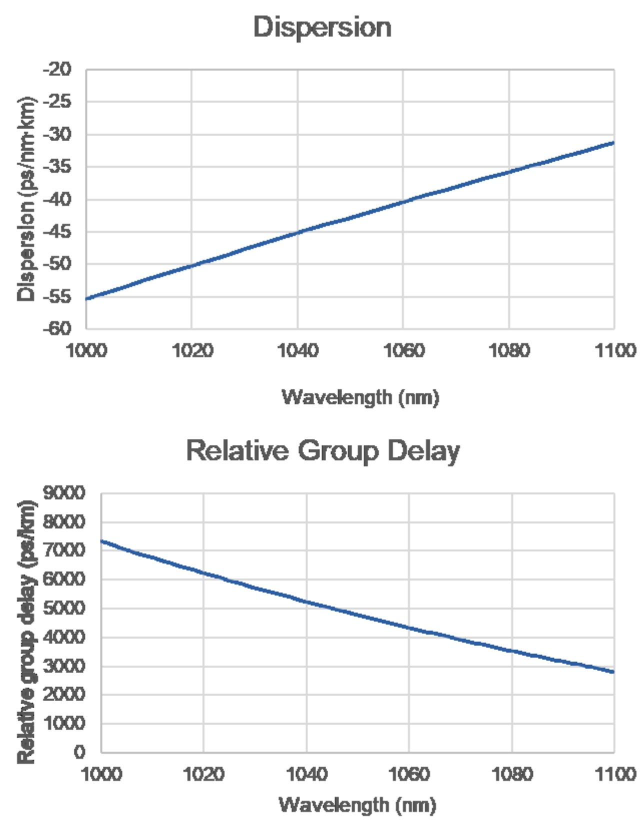

Figure 3: PLMA-YDF-14/125-UF Dispersion (top) and RGD (bottom).