



2.3 가 1 (11), 가 2 (12), 4  
 가 4 (14), 3 4  
 3 (13) (a)  
 , (b) (+) (-)  
 가 , / (c)

2

, , , , ,

2000 5 31

60/208,256

, , (+) (-)  
 (mode field diameter: MFD) , / " (tablet)"

A.

(net dispersion)

, 40Gbs 가 NRZ ( (solit  
 on), RZ, ).

100 " 10 " 10 " 100

(net zero dispersion)  
 (L<sub>i</sub>) (D<sub>i</sub>) 가 ( (L<sub>i</sub> · D<sub>i</sub>) , L<sub>i</sub> · D<sub>i</sub> " (overall)"

(power) 가 (bit rate), (repeater for spacing) mat) , NRZ, RZ

$L_i \cdot D_i$  (dD/d ) (setting) " S" WDM  $L_i \cdot S_i$  0 가

$L_i \cdot D_i$  가 0  $L_i \cdot S_i$  0 가 ,  $S_i$   $D_i$  가

(bit rate) ,  $D_i$  ( ,  $D_i$  ( ) (bit) " Q" 가

C99 Proceedings, 1 , 230 - 232 " (Anis) 1999 ECO (Continuous Dispersion Managed Fiber For Very High Speed Soliton System)"

B. (Process) (Proce ss)

가 가

가

C. " " " "

23 " " " " 08/844,997 1997 11 6 PCT 1997 4 WO/97/410 76

(scoring)/ (cutting) (snapping), (water jet) (saw) (core cane) (cladding) 가

(mismatch) (mode field diameter: MFD)

- (a)  $n_c \% = 100 \cdot (n_c^2 - n_{cl}^2) / 2n_{cl}$ , 0 1.2  $(n_c)$
- ( ) 2.3 (alpha)
- :
- (b)  $n_m \% = 100 \cdot (n_m^2 - n_{cl}^2) / 2n_{cl}$ ,  $n_m \%$ 가 -0.3  $(n_m)$  -  
 (sub - region)" 가 1, 2, 3 4 ( "
- ( ) 1 ;
- ( ) 2 가 ;
- ( ) 4 가 ;
- ( ) 3 3 4 (transition region) -;
- (c)  $n_r \% = 100 \cdot (n_r^2 - n_{cl}^2) / 2n_{cl}$ ,  $n_r \%$ 가 0 +0.5  $(n_r)$  (ring region)

, n<sub>cl</sub>

2

, m %

R<sub>c</sub>/R<sub>m</sub> < 0.6 m % - 0.55 ;

R<sub>c</sub>/R<sub>m</sub> < 0.45 m % - 0.50;

R<sub>c</sub>/R<sub>m</sub> < 0.4 m % - 0.45;

R<sub>c</sub>/R<sub>m</sub> < 0.3 m % - 0.30 ;

R<sub>c</sub>

R<sub>m</sub>

:

3

(+)

(-)

가 :

(1) ( , L<sub>i</sub> • D<sub>i</sub> ) 1 ps/nm - km ,

(2) 0.04 ps/nm<sup>2</sup> - km ,

(3) (-) 0.5 ps/nm - km ,

(4) (-) 가 0.5 ps/nm - km ,

(5) (+) 가 0.3 ps/nm - km ,

(6) (+) 가 0.3 ps/nm - km ,

/ ,

(7) (+) (-)

10 , 6 가 .

(3) (5)

(fiber population),

10

, N

:

가

x<sub>i</sub>

,  $\bar{x}$

$$S.D. = \sigma = \sqrt{\frac{1}{N} \sum_{j=1}^N (x_j - \bar{x})^2}$$

(data)가

가 (group) , EIA/TIA - 4  
 55 - 169A(FOTP - 169) " (interferometry technique), 1996 11 15 Optics Letters 21 , 21 L.  
 F.Mollenauer, P.V.Mamyshev, M.J.Neubelt " " 4  
 가 (+) (-)  
 4가 ,  
 , 4가 , 500 m 100 m 0.1 ps/nm - km  
 , 500 m

가 (routine) , ,

n 1983 Electronic Letters 19 , 712 - 714 . Petermann . See K. Peterman  
 (variable aperture method in the far field: VAMFF) Petermann  
 가 Hankel  
 2 가 Petermann Pask  
 . See C. Pask 1984 Electronic Letters 20 , 144 - 145  
 Petermann

가 / 1 2

(a) , (ring) ; 2.  
 3

(b) (a) ;

(b) :

( ) 가 0.04 ps/nm<sup>2</sup> - km ;

( ) , 0.5 ps/n  
 m - km

5, (Silica)

- (a)  $n_{cl}$  가 , 가 , :
- ( ) (germanium) 가 :
- ( ) (fluorine)(fluorine) 가 ,  $n_m$   $m\% < 0$  가  
 $m\% = 100 \cdot (n_m^2 - n_{cl}^2) / 2n_{cl}$  ;
- ( ) 2.3 가 ;

- (b) 4
- (+)  $P^+(r)$  가 ,  
 $r$  ,  $r^1$  , (-)  $P^-(r^1)$  ,  $r^1 = r$  , 1.  
 (+) (preform) - (over-clad) , (-)

- 1 : 1
- 10 ;
- 11, 12, 13, 14 1, 2, 3 4 ;
- 15a, 15b, 15c .

$R_c, R_m, R_r, c\%, m\% r\%$  1 (10)

$$\Delta(r)\% = \Delta(r_0)\% [1 - (|r-r_0| / (r_1-r_0))^a]$$

$r_0$  ,  $r_1$  (r)%가 0 ,  $r$   $r_1$   $r$   $r_f$  가  $r_1$  - 2.3  
 $r_f$  - 2.0 가 1.5

- 1 , 1, 2, 3 , 4 , 1 1

1  
 가 ( 가  
 0.25 dB/km ), ( , 1550 nm 0.34 dB/km  
 .) , (zero)  
 1550 nm 1700 nm (가 1520 nm 1650 nm )  
 1440 nm .

1  
 2 (section - by - section)

3 4 CP IP . 2 4,  
 가

%  
 (delta) 3 (+) / (+)  
 (-) / (-) 4 가 가

5 3 (CP ) , 4 (IP ) 가

6 3 가 가 (fluorine) 가  
 (cracking) . 4 가

(+) (-) 가  
 가 WDM , 2  
 (supra) ,

0 가

가 ( (+) (+) (-) ( (+)  
 -)) 0 가 가 가 (+)  
 (-) 가 가 (-) (-) 가 (+)  
 (+) 가 (-) (-) 가 .

(+) (-) 가 (-) (+) 가 . ,

, 가 ( , Corning Incorporated SMF - 28

), 0 (NZDSF)

가 , -0.05 ps/nm<sup>2</sup> - km (+) (-) 가 .

(-) 40 μ<sup>2</sup>) 가 , (-) (-) , 55 μ<sup>2</sup> 80 μ<sup>2</sup> 가 (

(mismatch) 가 (MFD) 가

/ (pulse) 2 4 .

, 가 ( ) (tapper) 가

가 가 , (-) 가 가 , 가

가 가 (+) , (-) 가 , 가

-) ,가 (+) 가 (

(-) 0 가 가 (+) (-) 가

( , (+) (+) (-) , (-) (+) (-) ,

가 0 (+) (-) ).

가 (+) (-) (+) (-) ( 가 ,

Di/Si/MFDi " CP" ) 3 .

, , , ( c) 2 .

3 CP

(+) , (-)

3 /

3

3

(over) -

가

3

가 ,  
(error)

(span)

가

가

가,

가

가

가

(+) (-)

가

가

(+) (-)

(2)

가

(1)

3

가

(+) (-)

(1)

가

(2) 가

가

(3) /

가

(4)

가

가 , , 가 .

가 , 가 가 .

$$\frac{\textcircled{A}}{A} \frac{dn(r)}{dr} I(r)rdr$$

, n(r) , l(r) r .  
 가 , 가 (+) (-) 가

, (+) (-) 가 .

4 ( " 가 " " IP" ) .  
 가 +12 , - 30 ps/nm - km ( c) 가 4 0.03 ps/nm - km<sup>2</sup>

5 , 5 3

, , 4 (simulation) 3 3

(perturbation) ( , 가 ) .  
 가 5 가 (set)

5 , 4 IP 3 CP 가 4 .  
 가 가 4 (jacketing)  
 3

가 ( ) CP (stage) (dopant) 가 (dicing)/ (sawing) CP IP 가 (stress) (fluorine)

e) 가 3 가 6 (21) (20) (fluorin

6 3 4 CP IP (dicing) (slicing) 가 6 3 CP 가 0.6 -0.3 4 3 4 3 4.5 0.2

가 08/844,997 1999 1 28 09/239,509 "

[ 1 ] 1

$R_c$	$1\mu m < R_c < 4\mu m$
$R_m$	$2\mu m < R_m < 12\mu m$
$R_r$	$3\mu m < R_r < 20\mu m$
$c\%$	$0.5\% < c\% < 1.2$
$m\%$	$-0.7 < m\% < -0.3$
$r\%$	$0.0 < r\% < 0.5$

[ 2]

$R_c$	2,16 $\mu$
$R_m$	6.30 $\mu$
$R_r$	7.50 $\mu$
$c$ %	0.8
$m$ %	- 0.41
$r$ %	0.25
$c$	8

[ 3]CP

(Over Clad)

(mm)	(ps/nm - km)	(ps/nm <sup>2</sup> - km)
44.36	3.4000	0.017650
46.1	- 1.3000	- 0.00074000
47.94	- 7.9600	- 0.029000
50	- 18.220	- 0.079000

[ 4] 4 IP

$R_c$	2.50 $\mu$
$R_m$	6.25 $\mu$
$R_r$	9.40 $\mu$
$c$ %	1.1
$m$ %	- 0.53
$r$ %	0.23
$c$	2

[ 5]CP IP

	CP	IP
+/- 0.001	23	4.1
+/- 0.001	4.3	1.89
+/- 0.001	3.5	0.5
+/- 0.1	14.3	5.25
+/- 0.1	1.4	0.81
+/- 0.1	1.2	0.5
	27.7	7.01

[ 6]

/ (Dicing)	7mm	9mm	12mm
CP /ID Saw	10%	5%	0%
CP /WIRE Saw	82%	70%	0%
IP /WIRE Saw	100%	-	95%

가

가

(scoring)/ (snapping), (water jet), (saw) 가  
 (cutting) (core cane) (cladding)

(57)

1.

$n_{cl}$  (cladding) (core)  
 (dispersion managed) (optical waveguide fiber),  
 (radius) 가 3 , 3

(a) (central core region)—

( )  $c\% = 100 \cdot (n_c^2 - n_{cl}^2) / 2n_{cl}$  ,  $c\%$ 가 0 1.2 (  $n_c$  );

( ) 2.3 (alpha value)

—;

(b)  $m\% = 100 \cdot (n_m^2 - n_{cl}^2) / 2n_{cl}$  ,  $m\%$ 가 - 0.3 (  $n_m$  )  
 moat region)— 가 1, 2, 3 4 (

( ) 1 ;

( ) 2 가 ;

( ) 4 가 ;

( ) 3 3 4 (transition region) —;

(c)  $r\% = 100 \cdot (n_r^2 - n_{cl}^2) / 2n_{cl}$  ,  $r\%$ 가 0 +0.5  $(n_r)$  (r ing region)

2.

1 ,

1.5

3.

1 ,

1, 2, 3 4

4.

1 ,

2 (slope) 4

5.

1 ,

(magnitude) 가 ,  
0.5 ps/nm · km

6.

5 ,

(+) (net positive dispersion) 가 ,  
0.3 ps/nm · km

7.

1 ,

(-) (net negative dispersion) 가 , 0.04ps/nm<sup>2</sup> · km

8.

$n_{cl}$

가 3

, 3

(a) —

( )  $c\% = 100 \cdot (n_c^2 - n_{cl}^2) / 2n_{cl}$  ,  $c\%$ 가 0 1.2 ( $n_c$ );

( ) 2.3 ;

( ) (outer radius;  $R_c$ )

—;

(b)  $m\% = 100 \cdot (n_m^2 - n_{cl}^2) / 2n_{cl}$  ,

$R_c/R_m < 0.6$   $m\%$  - 0.55,

$R_c/R_m < 0.45$   $m\%$  - 0.50,

$R_c/R_m < 0.4$   $m\%$  - 0.45,

$R_c/R_m < 0.3$   $m\%$  - 0.30

( $R_m$ ) ( $n_m$ ) — 가 1, 2, 3 4 ,

( ) 1 ;

( ) 2 가 ;

( ) 4 가 ;

( ) 3 3 4 —;

(c)  $r = 100 \cdot (n_r^2 - n_{cl}^2) / 2n_{cl}$  ,  $r\%$ 가 0 +0.5 ( $n_r$ )

9.

8 ,

1.5 .

10.

8 ,

1, 2, 3 4 .

11.

8 ,

2 4 .

12.

8 ,

0.5 ps/nm . km 가 ,

13.

12 ,

(+) 가 ,  
0.3 ps/nm . km .

14.

8 ,

(-) (net negative dispersion) 가 , 0.04ps/nm<sup>2</sup> . km .

15.

(fiber population) ,

10 (section) , (dispersion shifted fiber)

(D<sub>i</sub>) (S<sub>i</sub>) 가 ,

(-) (D<sub>i</sub>) (+) , (D<sub>i</sub>) ,

1ps/nm . km 가 ,

(S<sub>i</sub>) 0.04ps/nm<sup>2</sup> . km 가 ,

(-) (standard deviation) 0.5ps/nm . km .

16.

15 ,  
 (+) 0.3ps/nm . km

17.

15 ,  
 (+) 10 (mode field diameter) (-)

18.

15 ,  
 (+) 6 (-)

19.

15 ,  
 ( ) r , (+)  
 $P^+(r)$  가 ;  
 ( ) r'가 (-)  
 $P^-(r')$  가 ;  
 ( ) 가 ,  $P^+ P^-$  ,  $r' = r$

20.

19 ,  
 (+) 10 (-)

21.

19 ,  
 (+) 6 (-)

22.

( - ) 0.04ps/nm<sup>2</sup> . km 가 ,

0.5 ps/nm . km

23.

22

24.

( + ) 0.04ps/nm<sup>2</sup> . km 가 ,

0.3 ps/nm . km

25.

24

26.

(a) — 2.3 (profile) ; — ,

(b) (a)

(b)

( ) 0.04ps/nm<sup>2</sup> . km ;

( ) 0.5 ps/nm . km — — ,

27.

26 ,

( + ) 가 , 0.3 ps/nm . km

28.

26 ,

29.

26 ,  
1.5

30.

26 ,  
 $n_{cl}$  ;

$c\% = 100 \cdot (n_c^2 - n_{cl}^2) / 2n_{cl}$  ,  $c\%$ 가 0 1.2  $(n_c)$

31.

26 ,  
가 1, 2, 3 4 ,

- ( ) 1 ;
- ( ) 2 가 ;
- ( ) 4 가 ;
- ( ) 3 3 4

32.

31 ,  
2 4

33.

26 ,  
 $n_{cl}$  ;

$m\% = 100 \cdot (n_m^2 - n_{cl}^2) / 2n_{cl}$  ,  $m\%$ 가 0  $(n_m)$

34.

33 ,  
 $m\% - 0.3$

35.

33 ,  
 $(R_c/R_m)$   $(R_c)$  ,  $(R_m)$  가 ,  $m\%$   $R_m$   $R_c$

$R_c/R_m < 0.6$   $m\%$  - 0.55,

$R_c/R_m < 0.45$   $m\%$  - 0.50,

$R_c/R_m < 0.4$   $m\%$  - 0.45,

$R_c/R_m < 0.3$   $m\%$  - 0.30

36.

(silica core cane)

(tablet)

(a)  $n_{cl}$  — ,  
 , ( ) , ( )  
 $0$   $(n_m)$  가 , ( ) (fluorine) ,  $m\% = 100 \cdot (n_m^2 - n_{cl}^2) / 2n_{cl}$  ,  $m\% <$   
 — ; 2.3 가

(b)

37.

36 ,

(b) 4

38.

36 ,

1.5

39.

36 ,

$$c\% = 100 \cdot (n_c^2 - n_{cl}^2) / 2n_{cl} \quad , \quad c\% \text{가 } 1.2 \quad (n_c)$$

40.

36 ,

가 1, 2, 3 4 ,

( ) 1 ;

( ) 2 가 ;

( ) 4 가 ;

( ) 3 3 4

41.

40 ,

2 4

42.

36 ,

$m\%$  - 0.3

43.

36 ,

$(R_c/R_m)$  ,  $(R_c)$  ,  $(R_m)$  가 ,  $m\%$   $R_m$   $R_c$

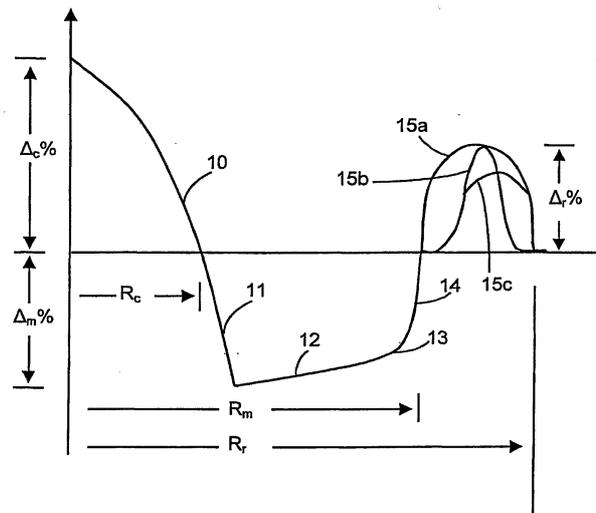
$R_c/R_m < 0.6$   $m\%$  - 0.55,

$R_c/R_m < 0.45$   $m\%$  - 0.50,

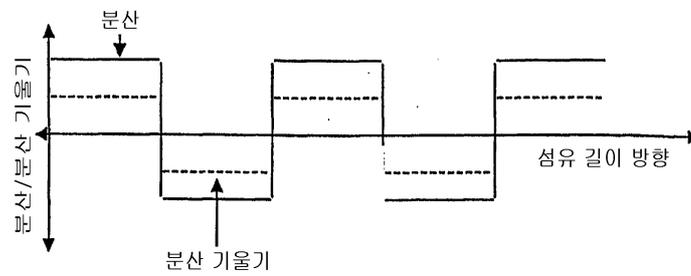
$R_c/R_m < 0.4$   $m\%$  - 0.45,

$R_c/R_m < 0.3$   $m\%$  - 0.30

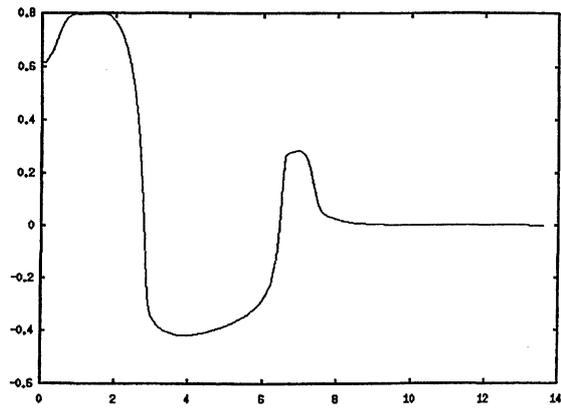
1



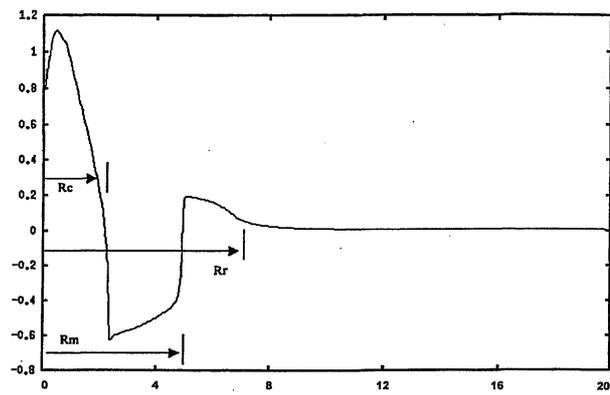
2



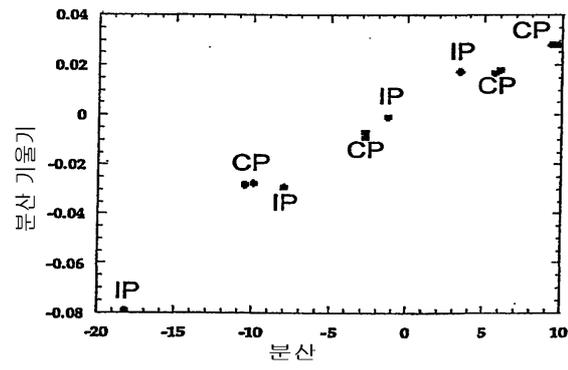
3



4



5



6

