CPTR-18076

TERALINK™

A cross-linked thermoplastic polymer for Optical Components that can withstand SMT processes

Sumitomo Electric Fine Polymer, Inc. (SFP)
Sumitomo Electric Industries, Ltd. (SEI)

Sep. 10, 2018

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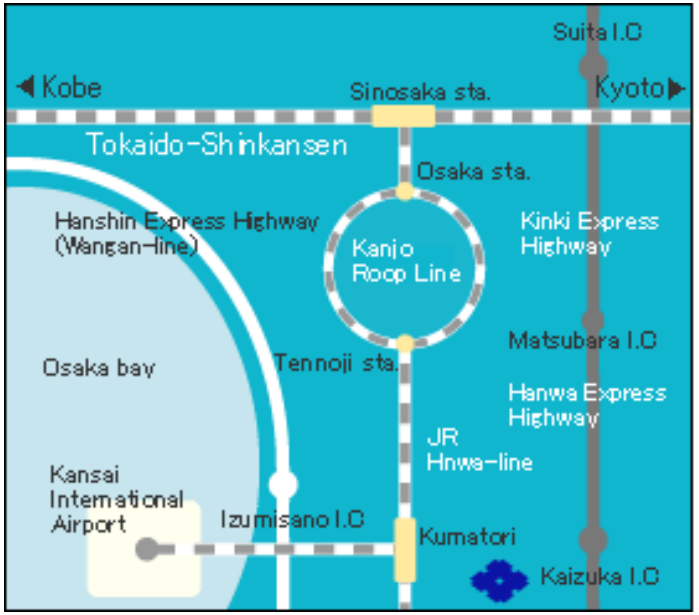
CONFIDENTIAL

Company Profile

Sumitomo Electric Fine Polymer, Inc. is a wholly-owned subsidiary of Sumitomo Electric Industries, Ltd. We specialize in electron beam irradiation technology and fluororesin processing technology supplying unique products to a wide range of industries including automobiles, information and communications, home electronics and infrastructure.

Company Name	Sumitomo Electric Fine Polymer, Inc.
Address	1-950, Asashiro nishi, Kumatori-cho, Sennan-gun, Osaka, 590-0458 JAPAN TEL:+81-72-452-1301
Activities	Development and production of products made of fine polymer materials
Capital	10 billion yen
Number of employees	Approximately 480



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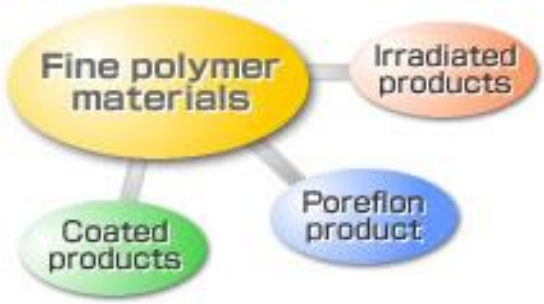
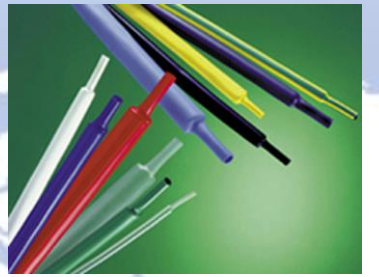
Products



- Irradiated Products
  - Heat-shrinkable tubing and heat resistant tapes
  - Thermoplastic polymer components (*TERALINK*)
- Functional Fluororesin Products
  - Fluororesin- coated aluminum products for cookers
  - Rollers for ink-jet printers
  - Porous materials made of PTFE for microfiltration



Irradiated Products

Functional Fluororesin Products

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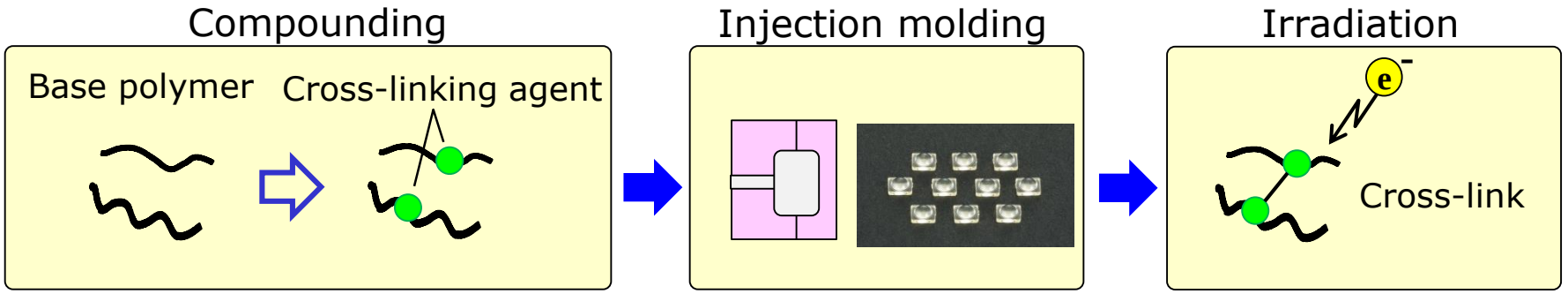
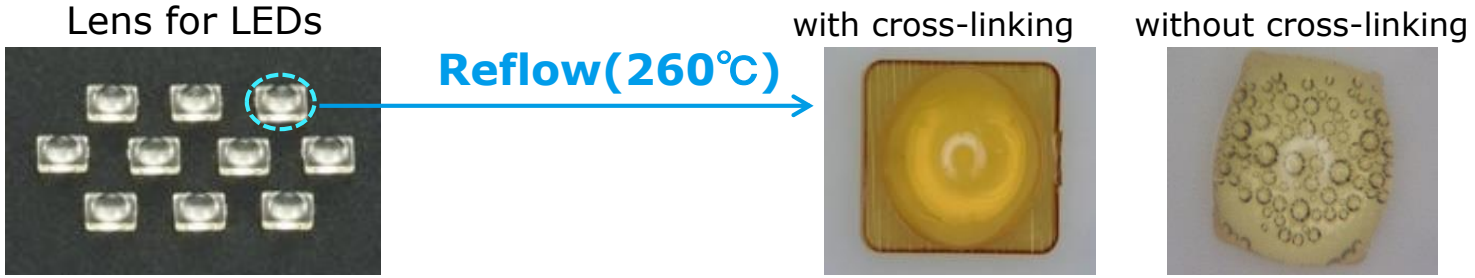
What is TERALINK?

- Thermoplastic polymer cross-linked by electron-beam irradiation



- Advantages
  - Structurally stable at temperatures above melting point
  - Retains original shape and transmittance under reflow process (260℃)
  - Improved resistance to wear
  - Improved resistance to chemicals



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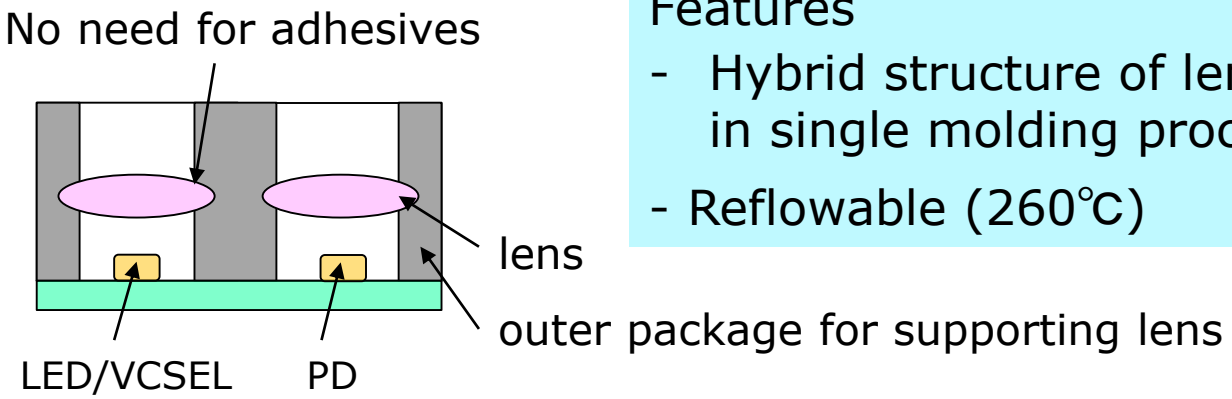
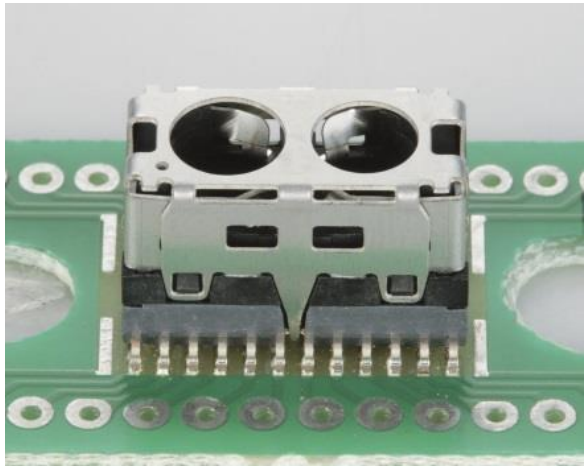
Application example: Optical connectors

■ Lens for optical connectors



Features
- Hybrid structure of lens and housing realized in single molding process
- Reflowable (260℃)

Optical connector



<Prod.>
- Optical connectors (POF:650nm)

<R&D>
- Optical connectors (MMF:850nm)
- lens package for LEDs & PDs

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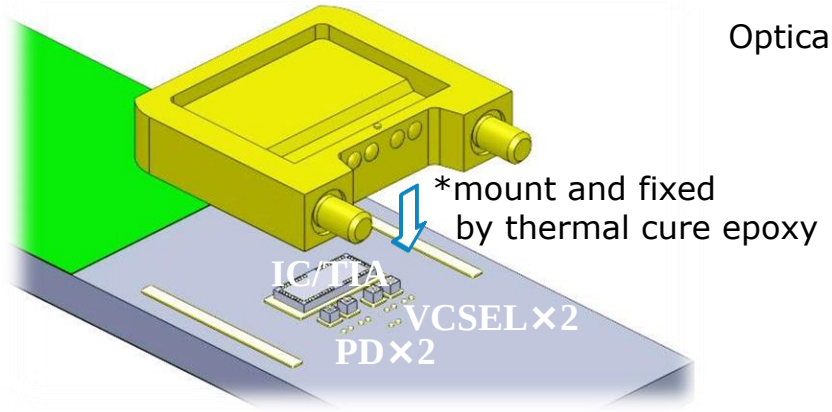
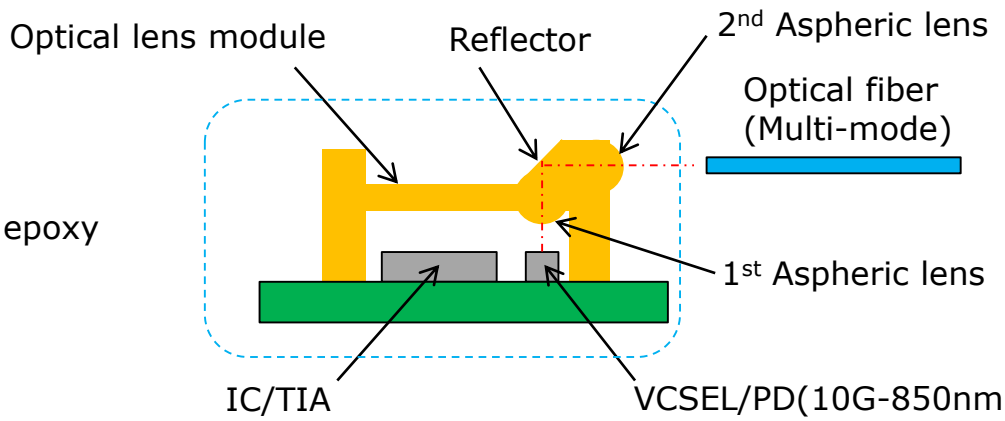
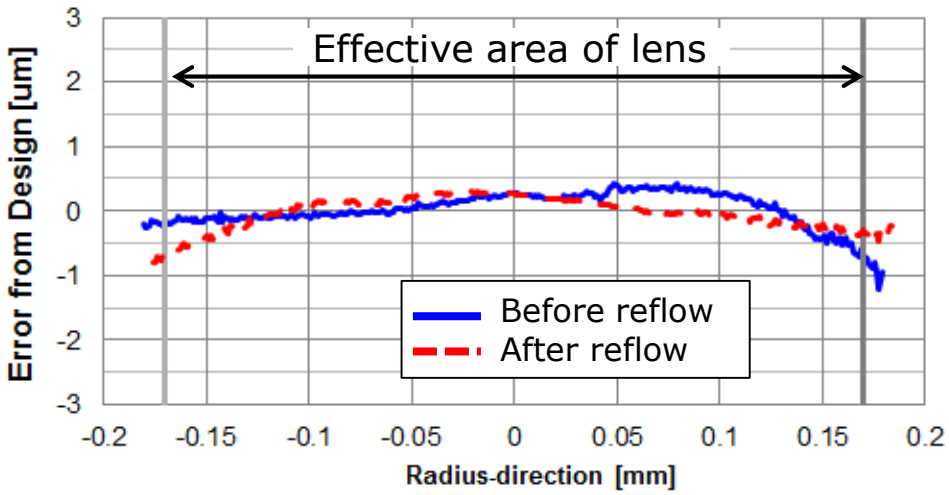
Application example: Optical lens module for VCSELs

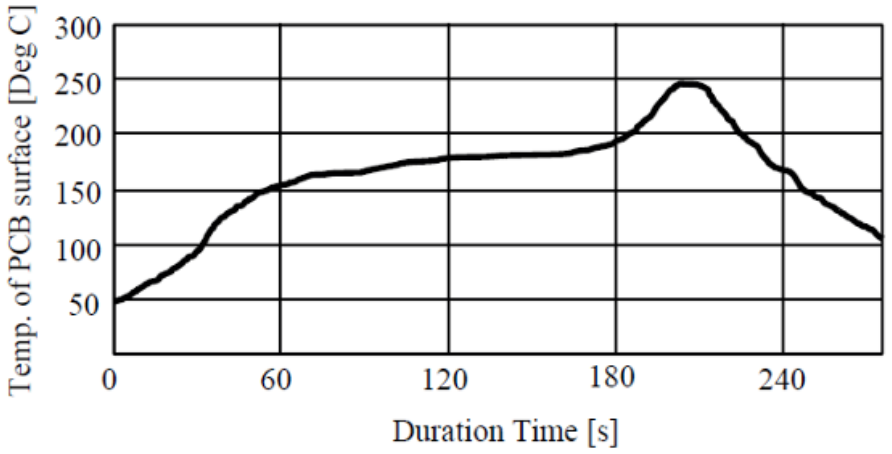
■ 10Gbit/s AOC lens module

Optical lens module









Deformation of the lens surface profile after reflow is within 1~2μm

T. Shimazu et al., Reflowable Thermoplastic Optical Lens Module for 10-Gbit/s Transmission with 850-nm VCSEL, OFC2015

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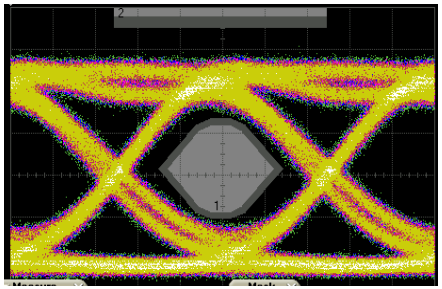
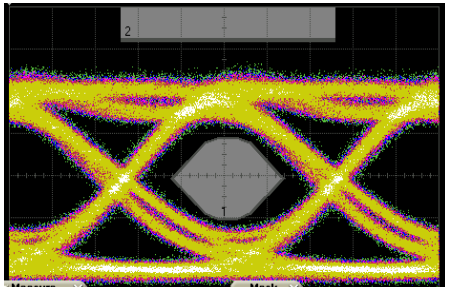
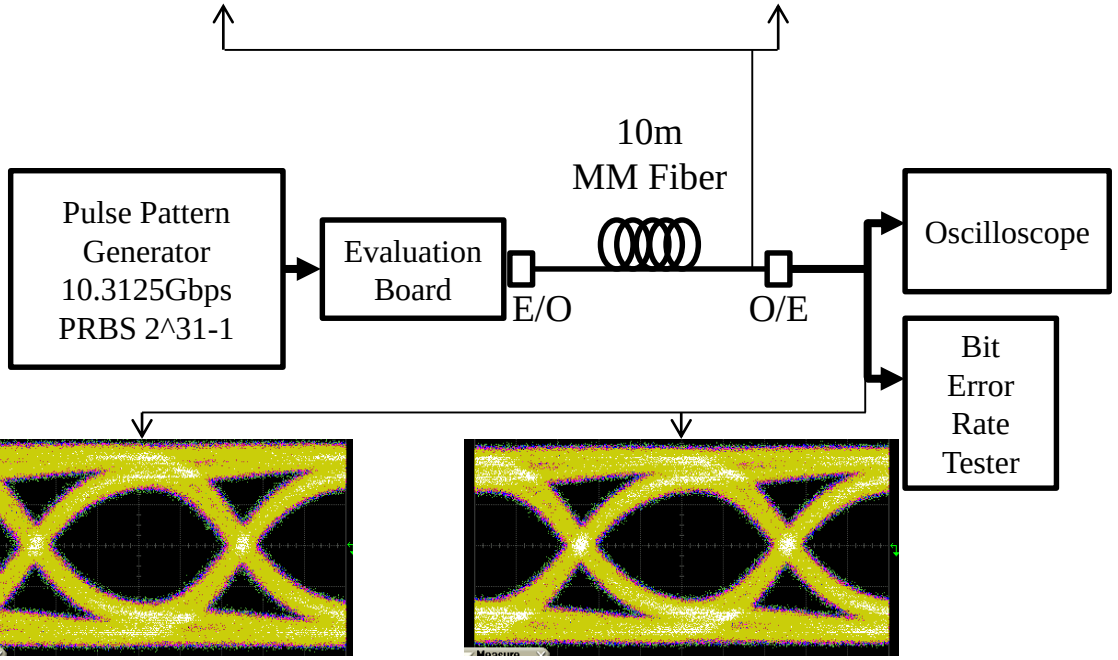
Demonstration of 10Gbits/s transmission



(a) Tx Optical waveform (Before Reflow)



(b) Tx Optical waveform (After Reflow)

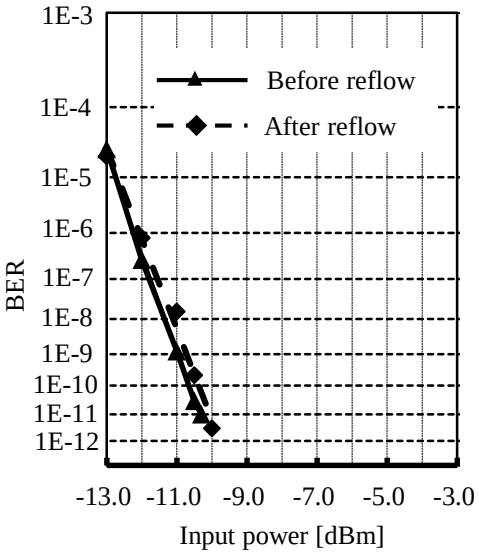


(C) Output waveform (Before Reflow)

(D) Output waveform (After Reflow)

Error Free !

*both Before and After reflow



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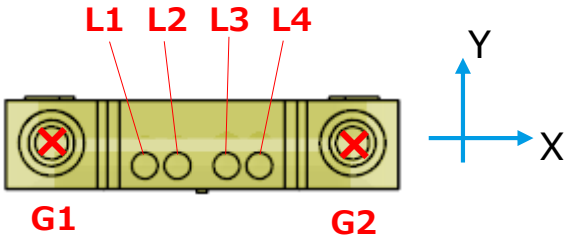
Shift in the lens position after reflow(*Measurement method*)

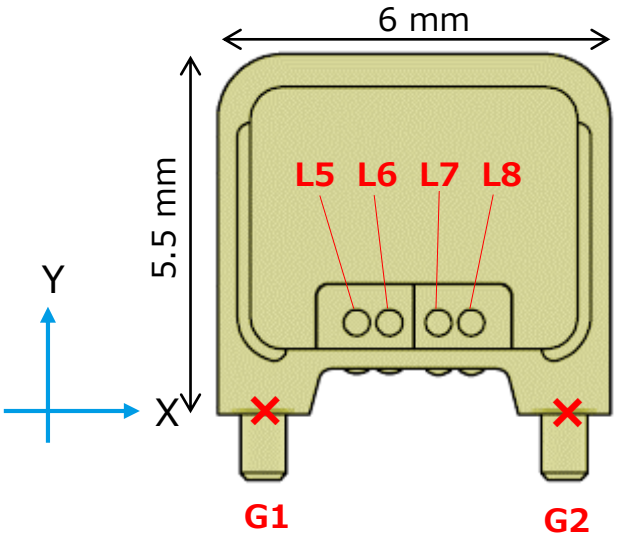
Measurements performed in the same manner as described in the previous pages.

◆**FRONT** view



Measurement flow
1.Set AOC lens on jig and place the jig on stage.
2.Measure bottom of guide-pin G1 and G2.
3.Origin is center of G1 and G2
4.Measure L1, L2, L3, L4 lens positions and G1-G2 pitch.

◆**TOP** view



Measurement flow
1.Set AOC lens on stage with L5~L8 facing up (see image on left).
2.Measure bottom of guide-pin G1 and G2.
3. Origin is center of G1 and G2
4.Measure L5, L6, L7, L8 lens positions.

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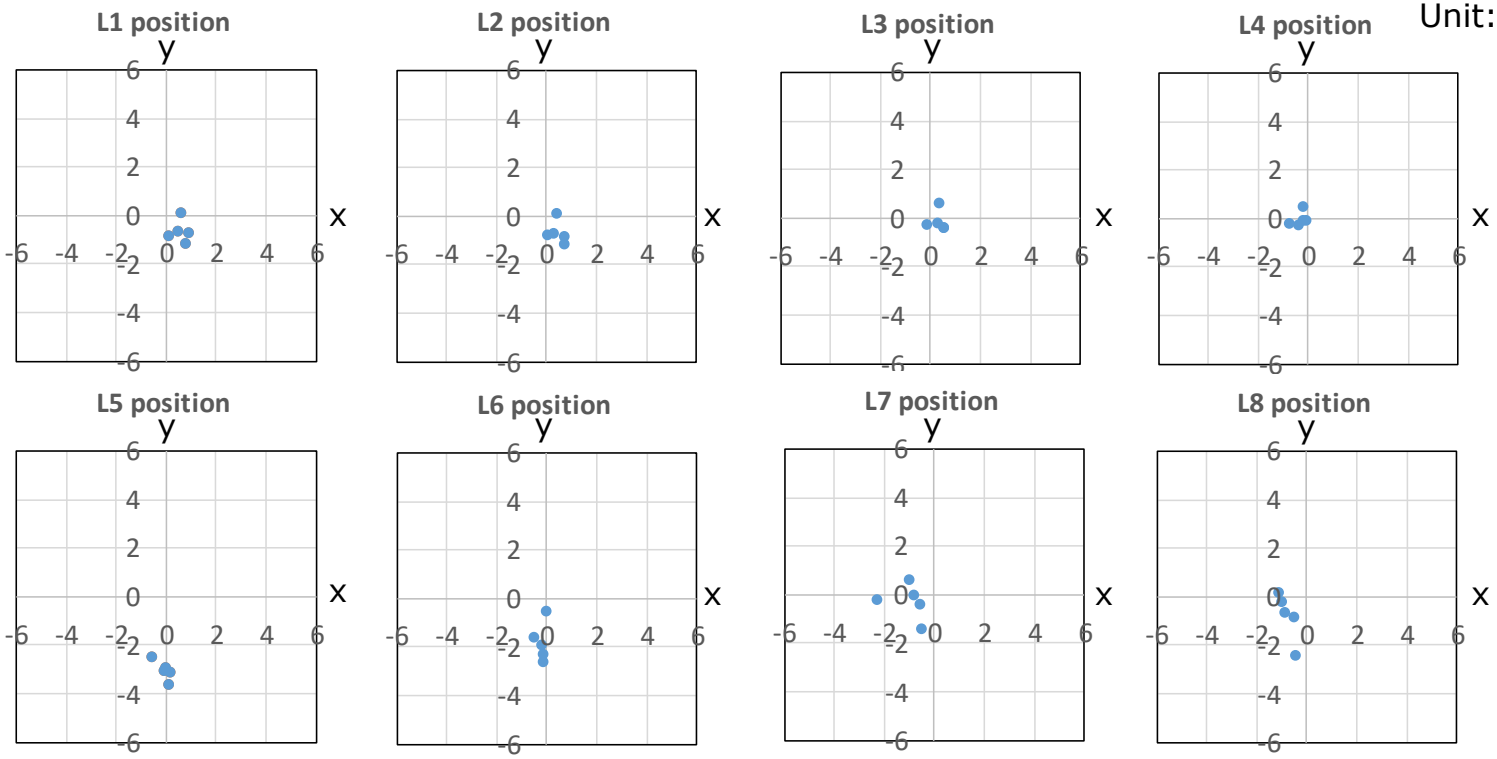
Shift in the lens position after reflow(*Results*)

*heat treatment in oven @260C x 5min.

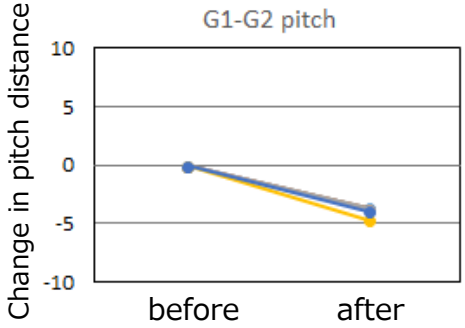
Lens positions and G1-G2 pitch after simulated reflow*

Unit:μm



FRONT view

TOP view



- ✓ FRONT view: Max shift of L1~L4 lens is 1.1μm
- ✓ TOP view: Max shift of L5~L8 lens is 3.6μm
- ✓ G1-G2 pitch: Max shift is 4.7μm

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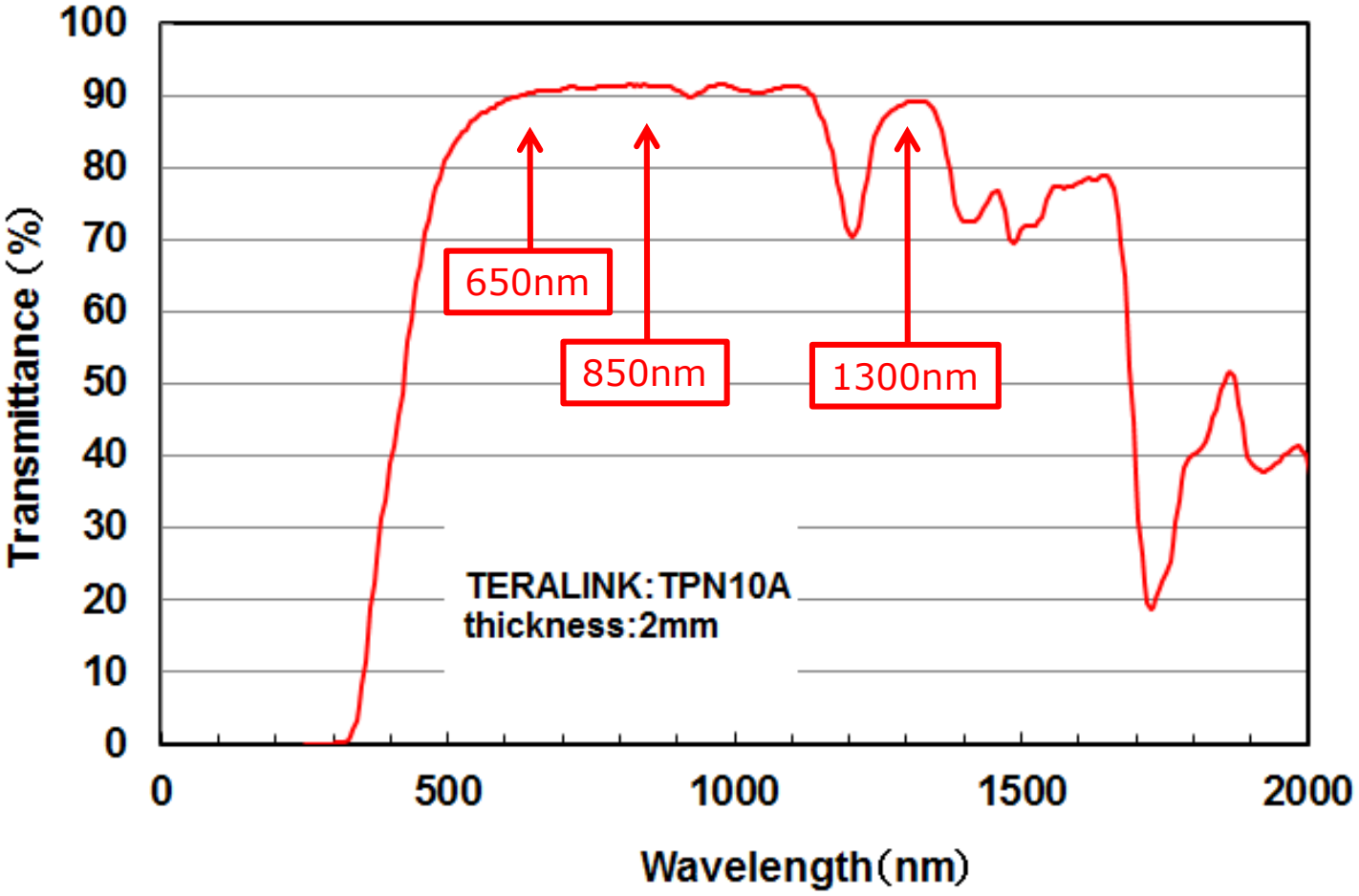
Transmittance spectrum



T>90%@650~850nm, ~90%@1300nm, 75~80%@1550nm

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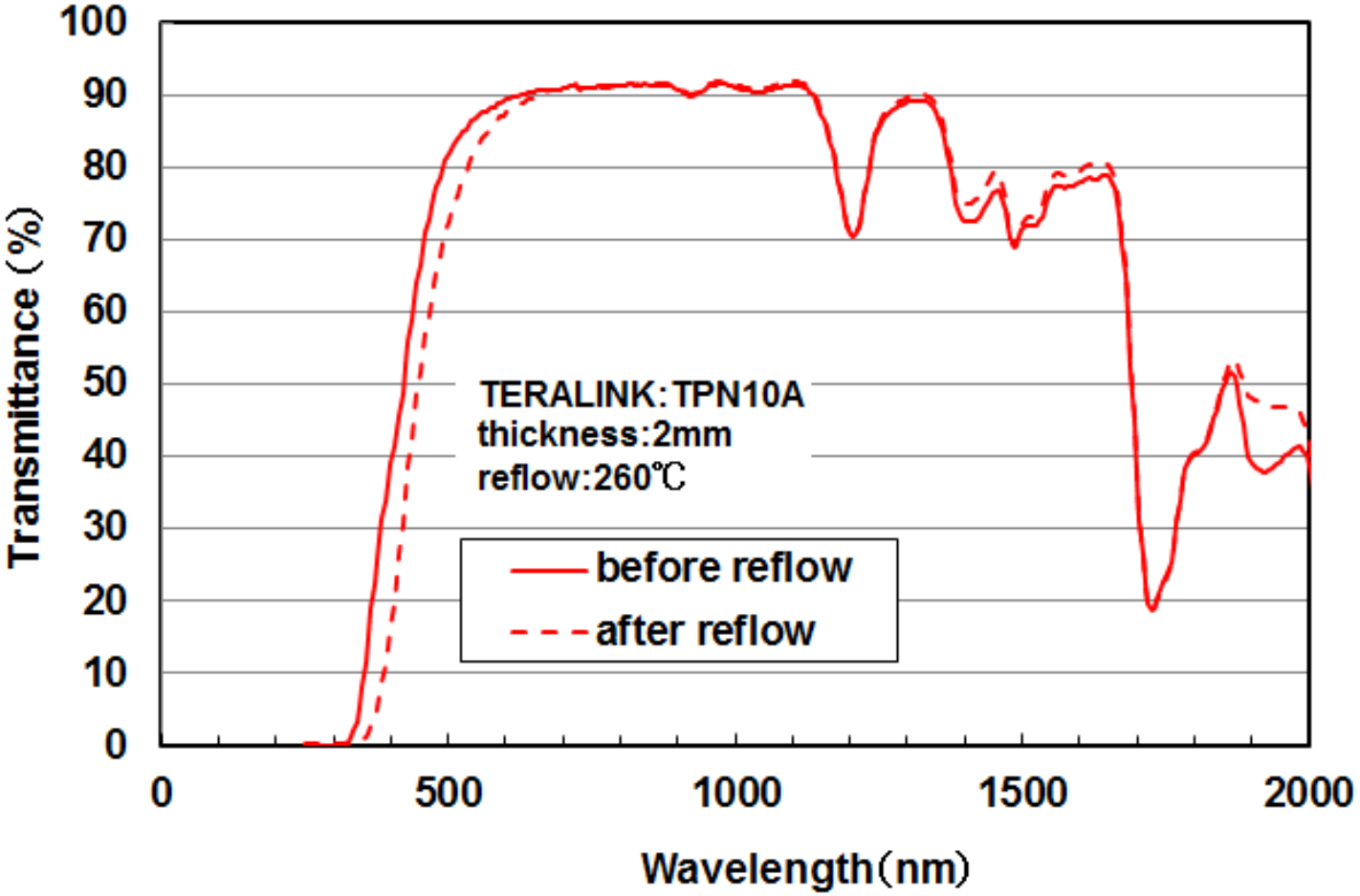
Effect of reflow on transmittance



Transmittance spectrum remains virtually unchanged above 650nm

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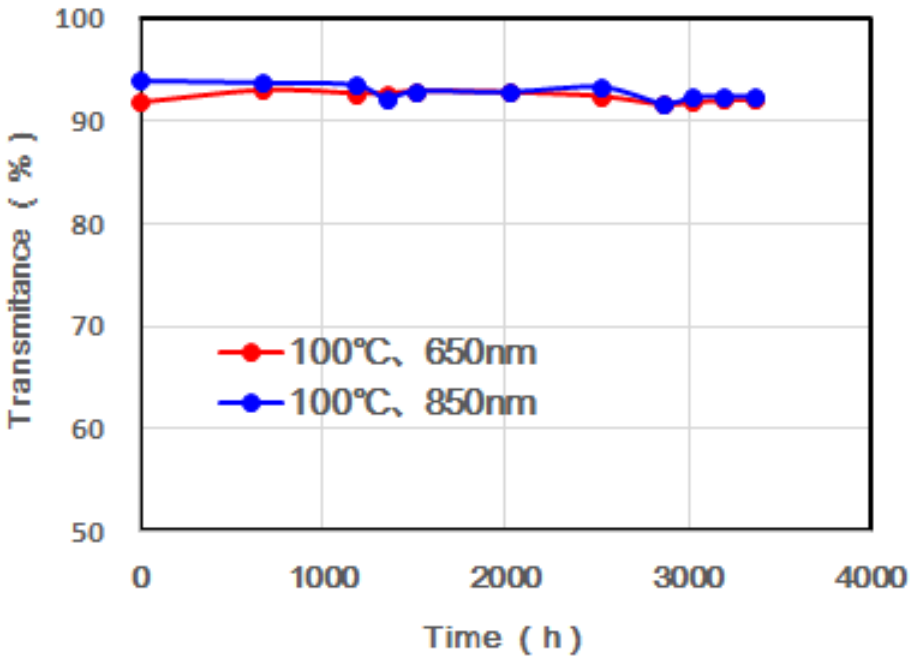
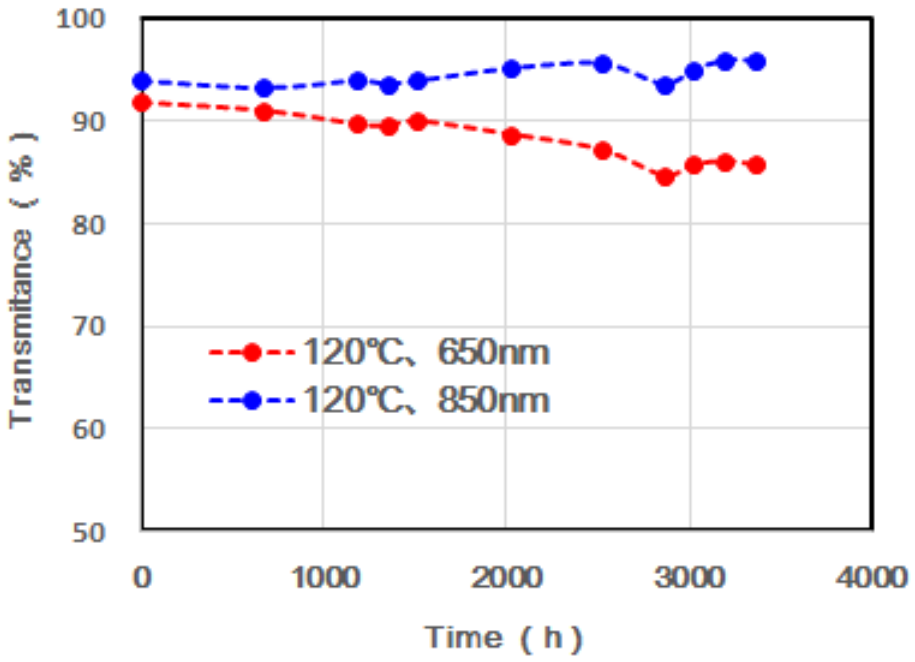
Reliability data on transmittance

Reliability at 100℃



Reliabiliy at 120℃



650nm ⇒ no degradation observed up to 3300h at 100℃
850nm ⇒ no degradation observed up to 3300h at 120℃

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Material properties

	Test method	Unit	TERALINK※1	PEI
Density	ISO1183	g/cm3	1.0	1.3
Refractive index	JISK7142	—	1.51	1.64
Transmittance (2mm)	JISK7361	%	91	-
Transmittance (2mm, 650nm)	—	%	90	89
Transmittance (2mm, 850nm)	—	%	91	89
Haze	JISK7361	%	1.7	-
Glass transition temperature	ISO11357	℃	153※2	217
Tensile strength at break	ISO527	MPa	73	110
Elongation at break	ISO527	%	29	60
Bending strength	ISO178	MPa	100	165
Bending elastic modulus	ISO178	GPa	1.8	3.5
Charpy impact strength (notched)	ISO179	KJ/m2	1.7	-
Water absorption (23℃/sat.)	ISO62	%	2.0	1.3
Water absorption (23℃/50%R.H.)	ISO62	%	1.0	-
Thermal expansion coefficient	ISO11359	10-4/K	0.9	0.6
Flammability	UL94	—	HB	V0
Specific volume resistivity	IEC93	Ω・cm	1.00E+11	1.00E+17

※1 Grade:TPN10A
※2 Teralink does not melt and keeps its original shape above Tg

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Process flow of Teralink products

	notes
Compounding of Teralink	Teralink compounds are not available for sale
Inspection (compound)	
Injection molding	
Gate cutting	
Inspection (molded lens)	Inspection items are determined upon customer request
E-beam irradiation	
Inspection (product)	
Packaging and Shipping	

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Summary

- TERALINK is a cross-linked thermoplastic polymer for Optical Components that can withstand SMT processes
- Features
  - Reflowable (260℃)
  - Transmittance is over 90%(600nm~1100nm)
  - Injection molding applicable (cost effective, high flexibility in design)
  - Hybrid structures of lens & supporting holder realized in a single molding process
- Applications include
  - Lens for SMT-type LEDs or PDs
  - Lens package for optical connectors
  - Optical components for multi-mode fiber applications (VCSELs)
- We appreciate your feedback!

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