TERALINK™

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

Sumitomo Electric Fine Polymer, Inc.
Innovation Core SEI, Inc. (ICS)
Sumitomo Electric Industries, Ltd.

July 2016

SEI's Five Business Domains

Automotive

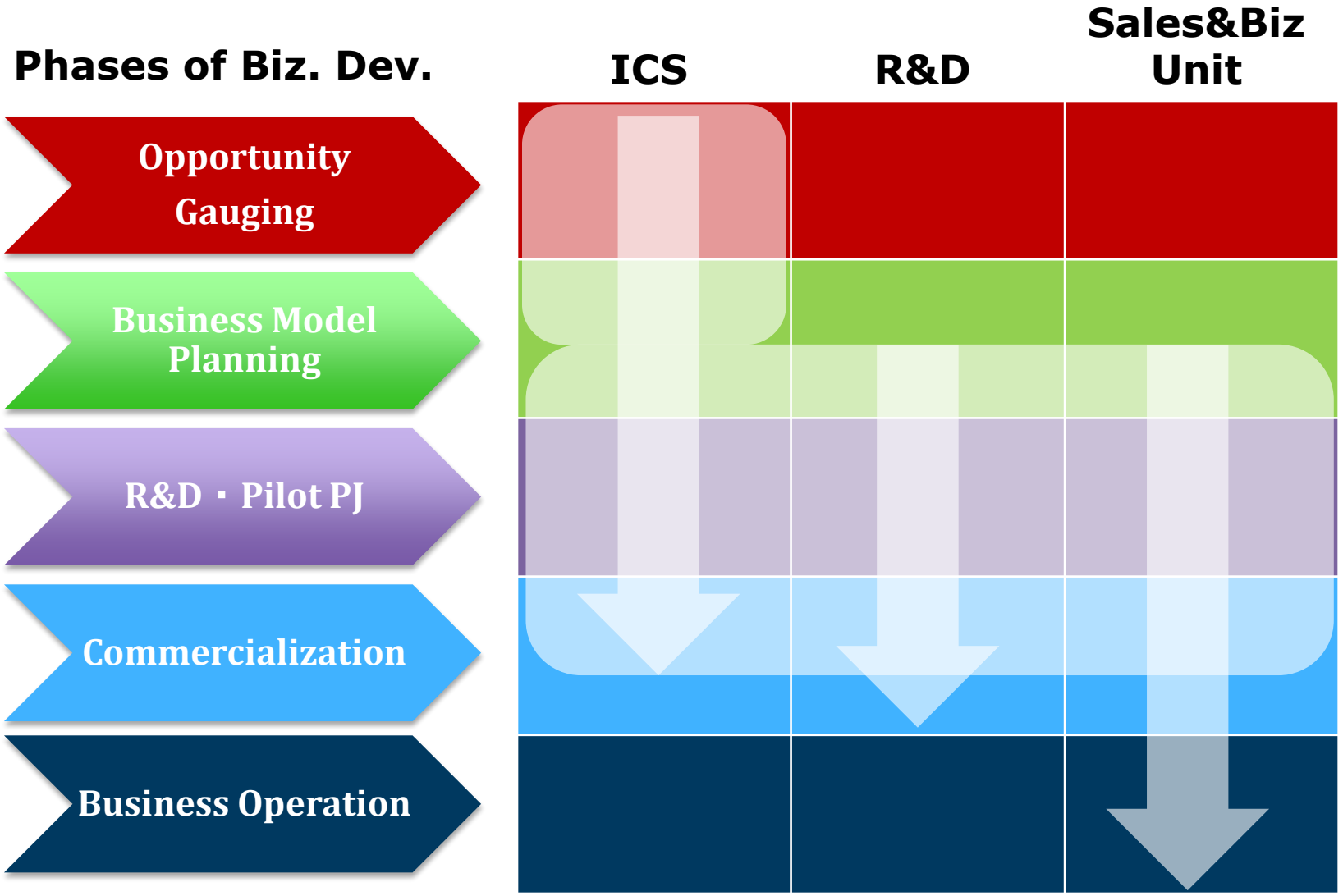
Electronics

Information Communications

Environment& Energy

Industrial Materials

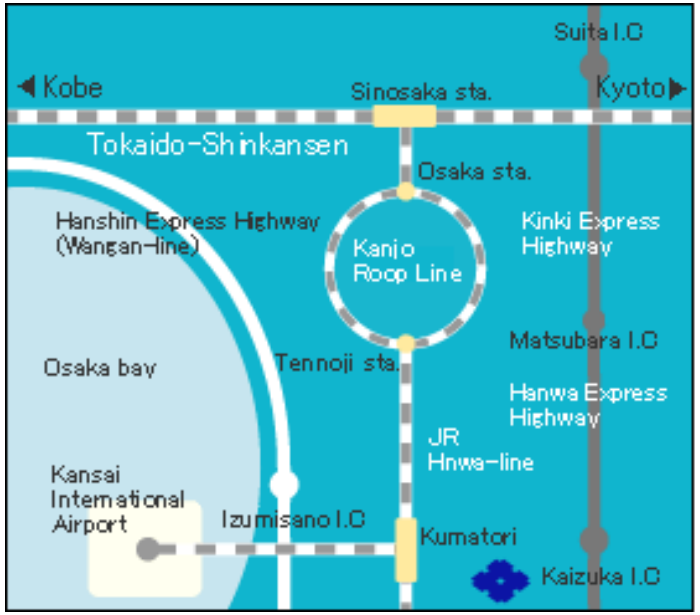
ICS Role: Creating New Biz. in North America



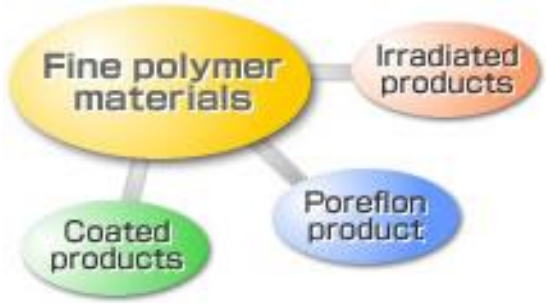
Company Profile

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



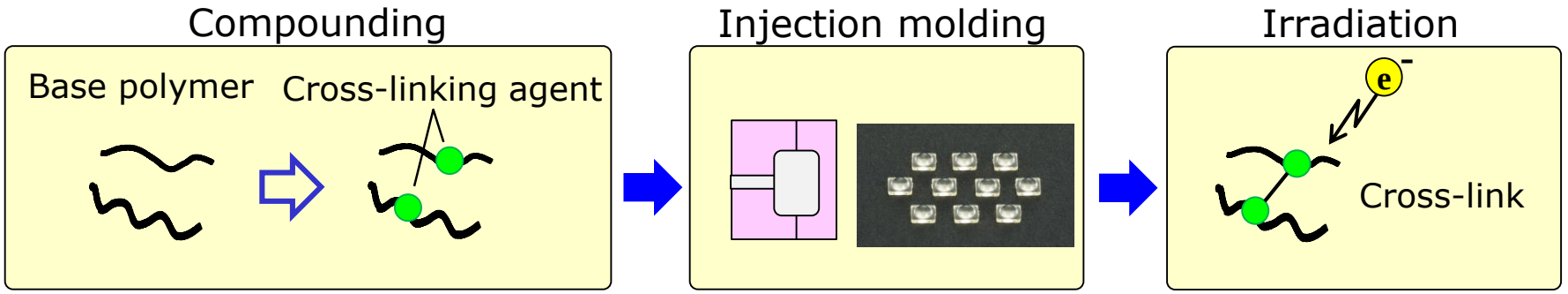
Products



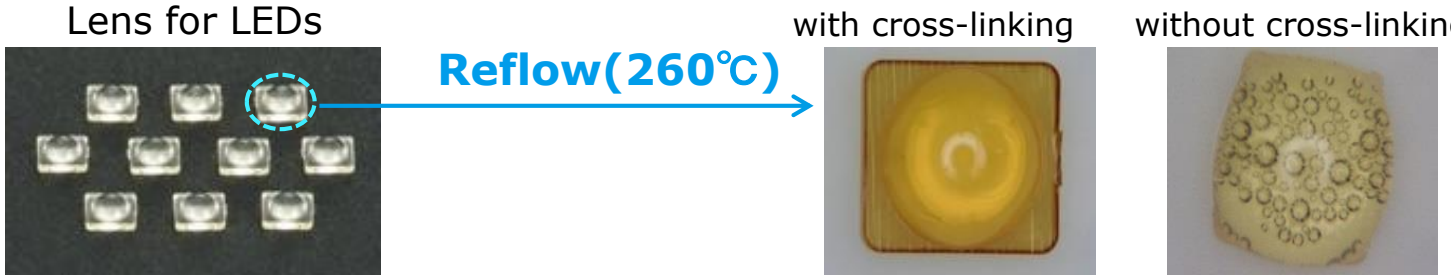
- Irradiated Products
  - Heat-shrinkable tubing and heat resistant tapes
  - Thermoplastic polymer components (*TERALINK*)
- Functional Fluororesin Products
  - Fluororesin- coated aluminum products for cookers
  - Rollers for ink-jet printers
  - Porous materials made of PTFE for microfiltration

What is TERALINK?

- Thermoplastic polymer cross-linked by electron-beam irradiation



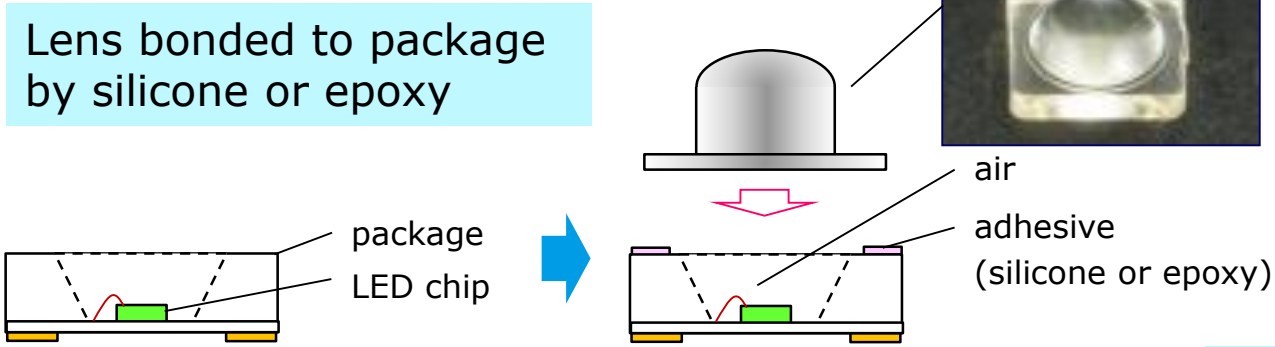
- Advantages
  - Structurally stable at temperatures above melting point
  - Retains original shape and transmittance under reflow process (260℃)
  - Improved resistance to wear
  - Improved resistance to chemicals



Application example: Lens for SMT LED packages

Lens for SMT LED packages

Lens bonded to package by silicone or epoxy



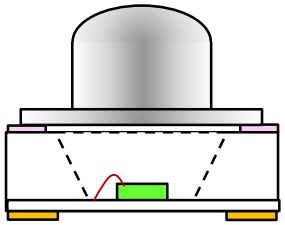
Top view of LED

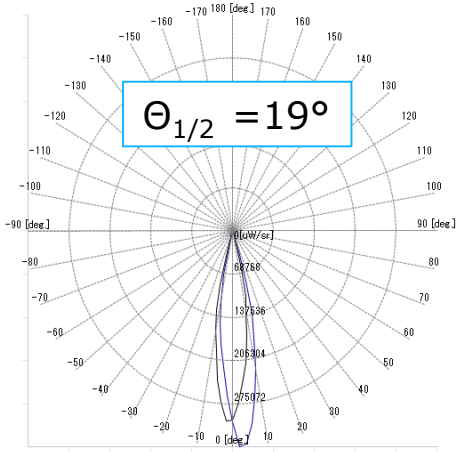
No deformation after reflow

Radiation characteristics

SMT LED with lens-bonded package

P_O =73mW
I_E =350mW/sr
I_F =120mA

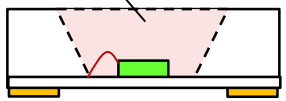


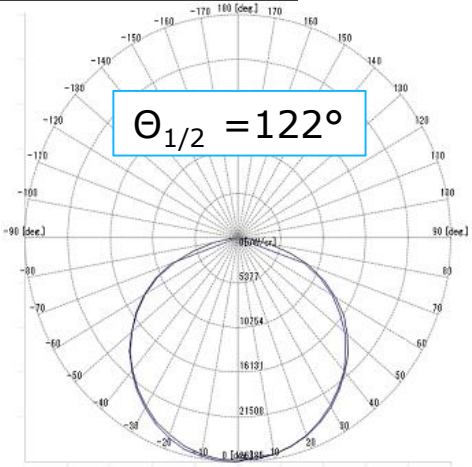


SMT LED without lens

P_O =84mW
I_E =270mW/sr
I_F =120mA

silicone





High power SMT LEDs with view angles < 20° realized by lens-bonded packages

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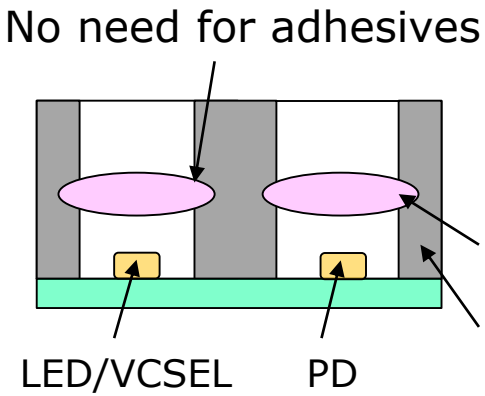
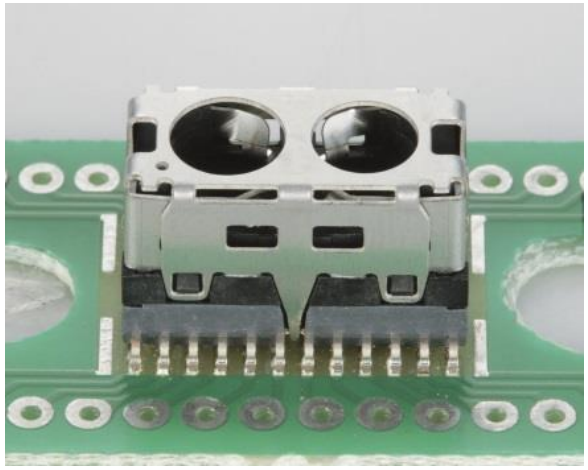
Application example: Optical connectors

■ Lens for optical connectors



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

Optical connector



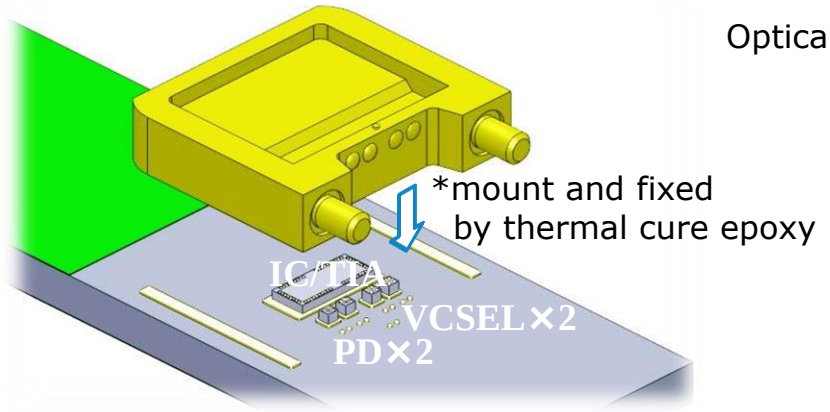
<Prod.>
- Optical connectors (POF:650nm)

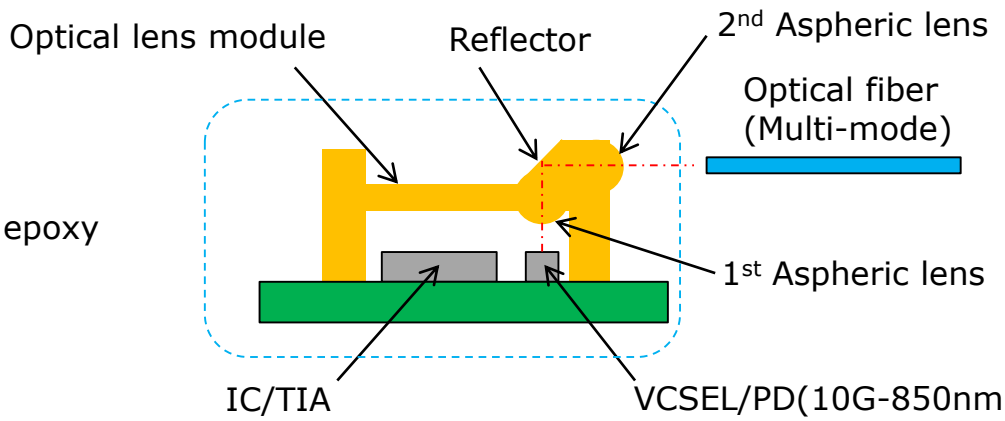
<R&D>
- Optical connectors (MMF:850nm)
- lens package for LEDs & PDs

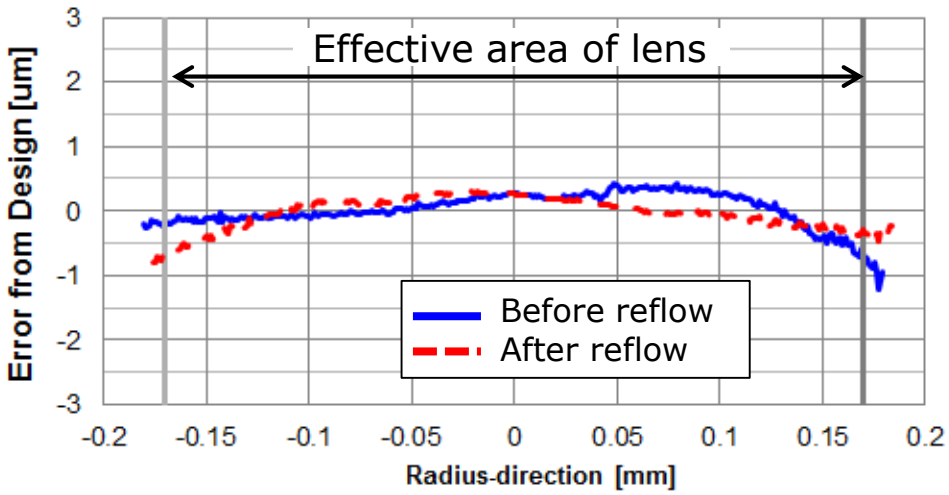
Application example: Optical lens module for VCSELs

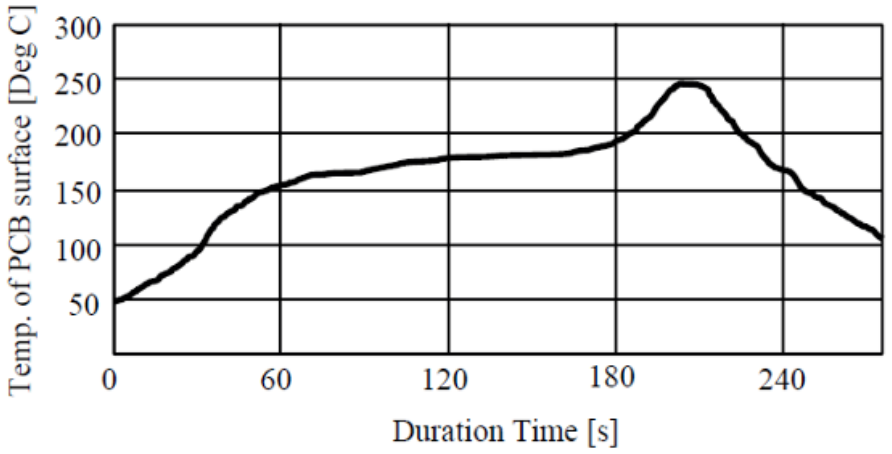
■ 10Gbit/s AOC lens module

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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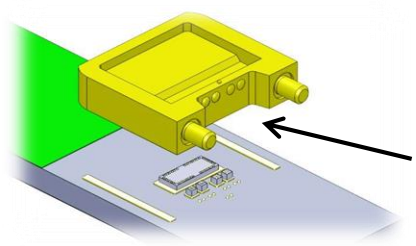
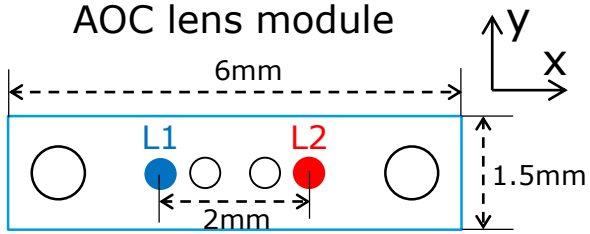
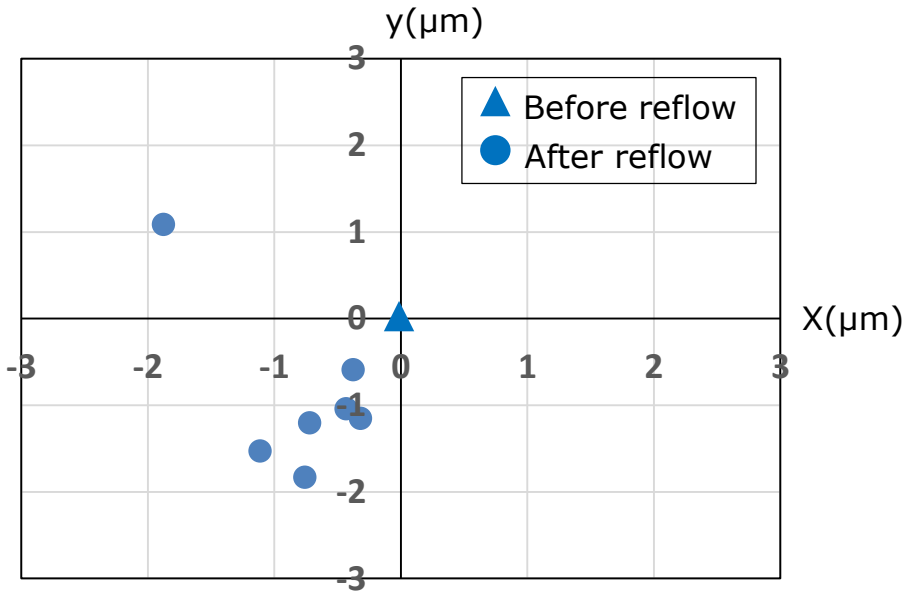
Shift in the lens position after reflow



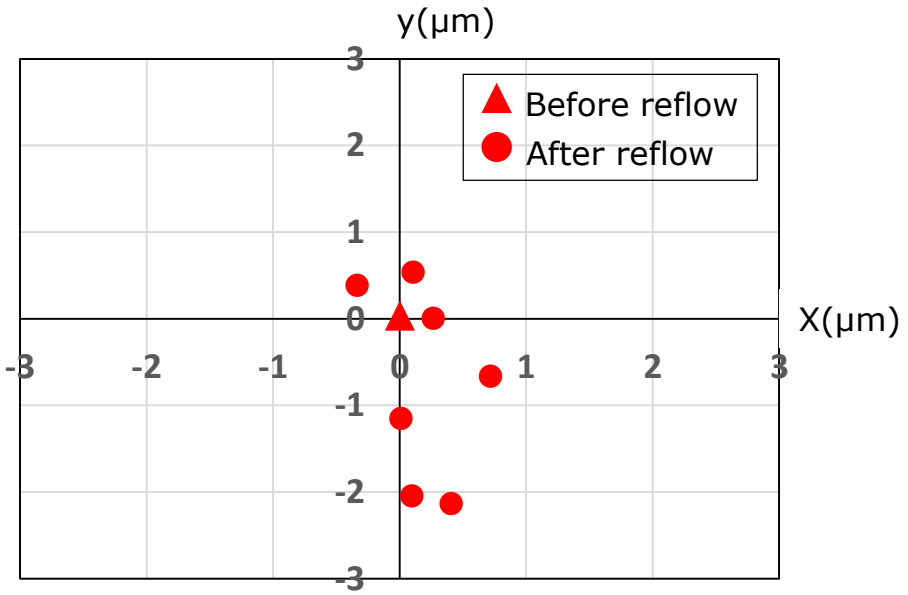


Test method
- Reflow performed on 7 samples
- Lens positions measured after reflow

L1 position

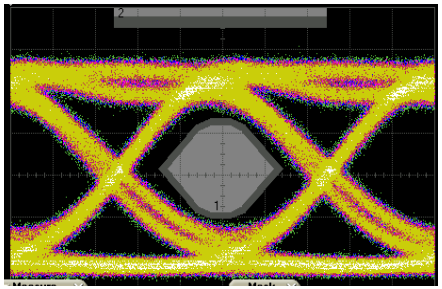


L2 position

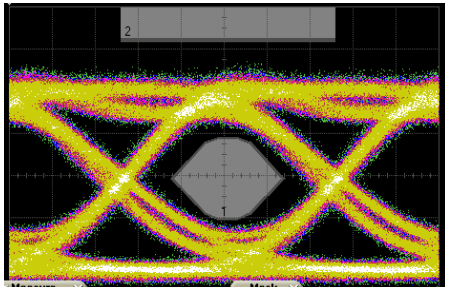


Shift in the L1, L2 positions after reflow is at most 2.1um

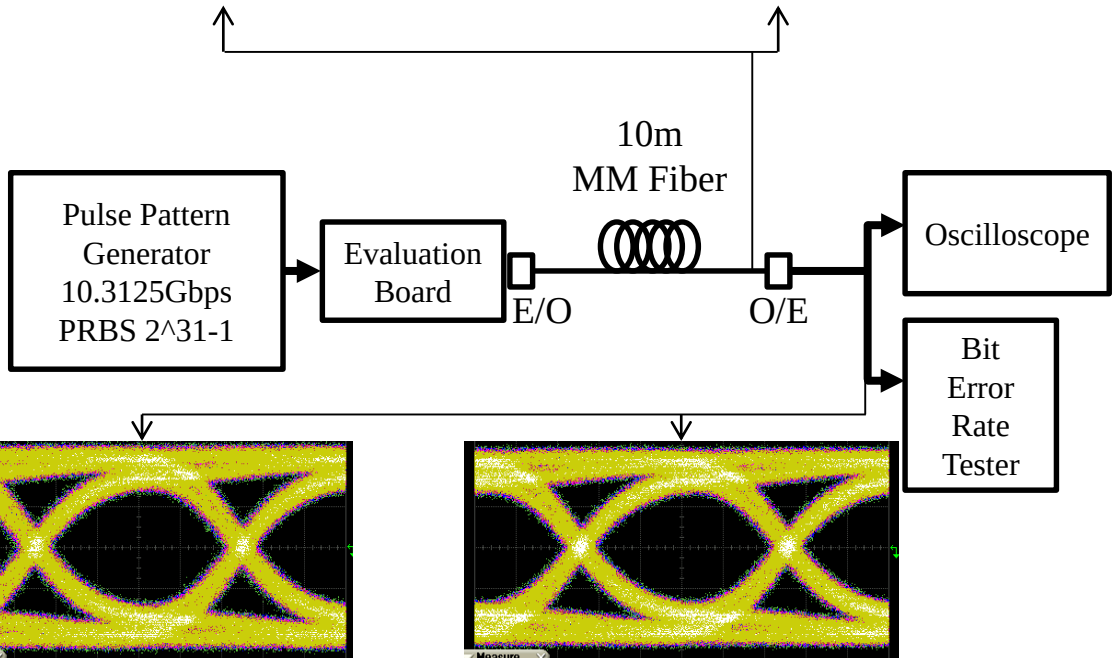
Demonstration of 10Gbits/s transmission



(a) Tx Optical waveform (Before Reflow)



(b) Tx Optical waveform (After Reflow)

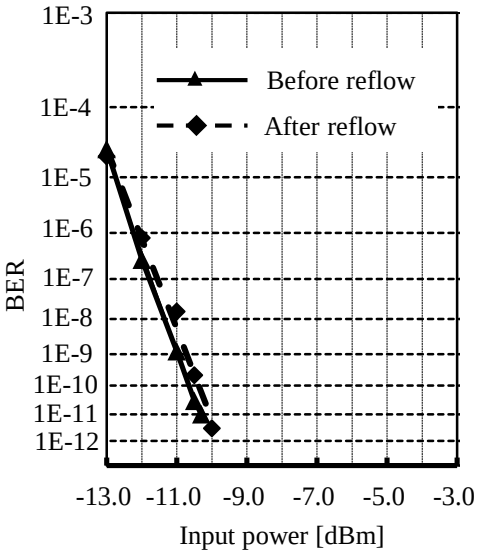


(C) Outupt waveform (Before Reflow)

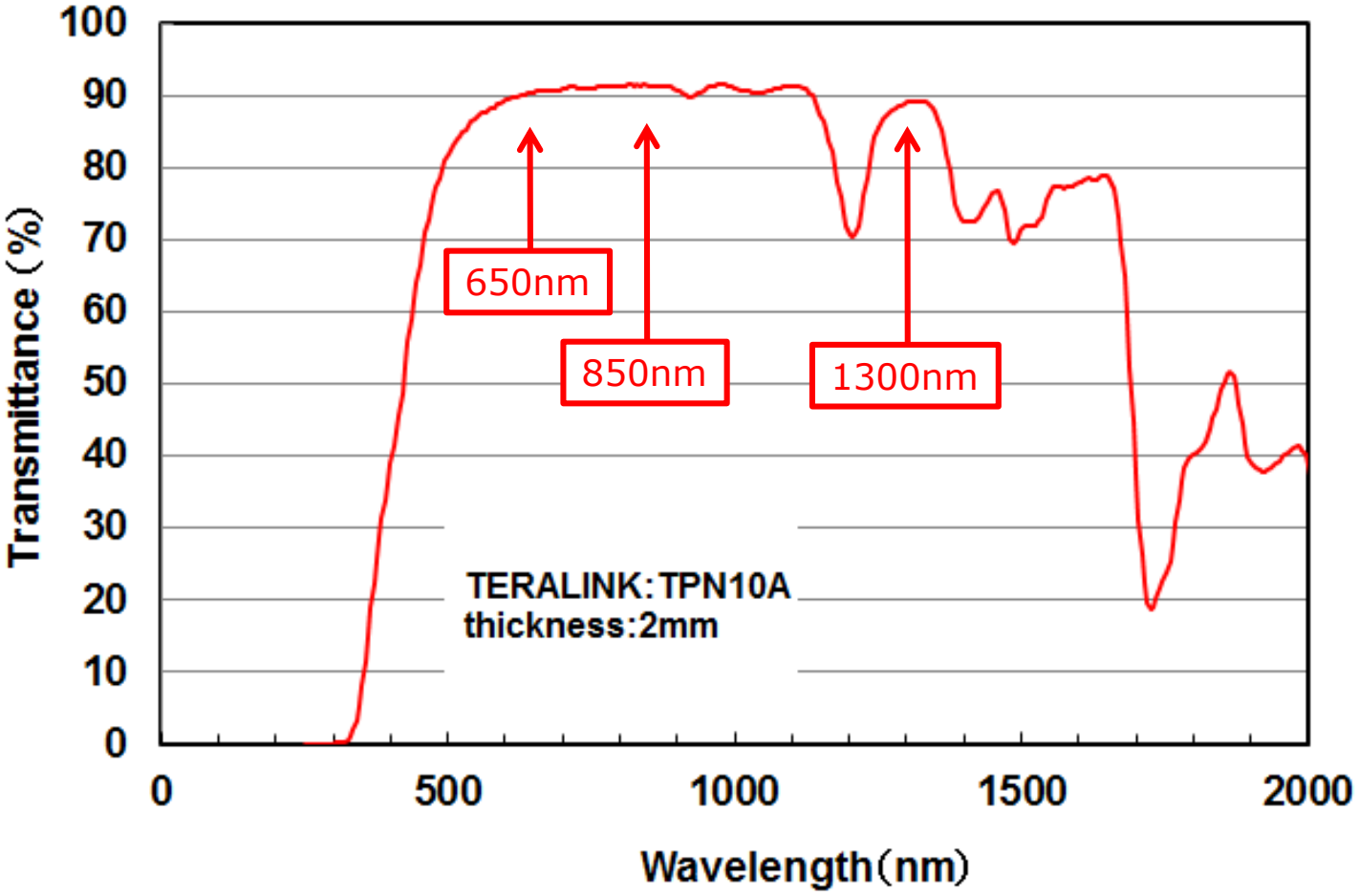
(D) Outupt waveform (After Reflow)

Error Free !

*both Before and After reflow

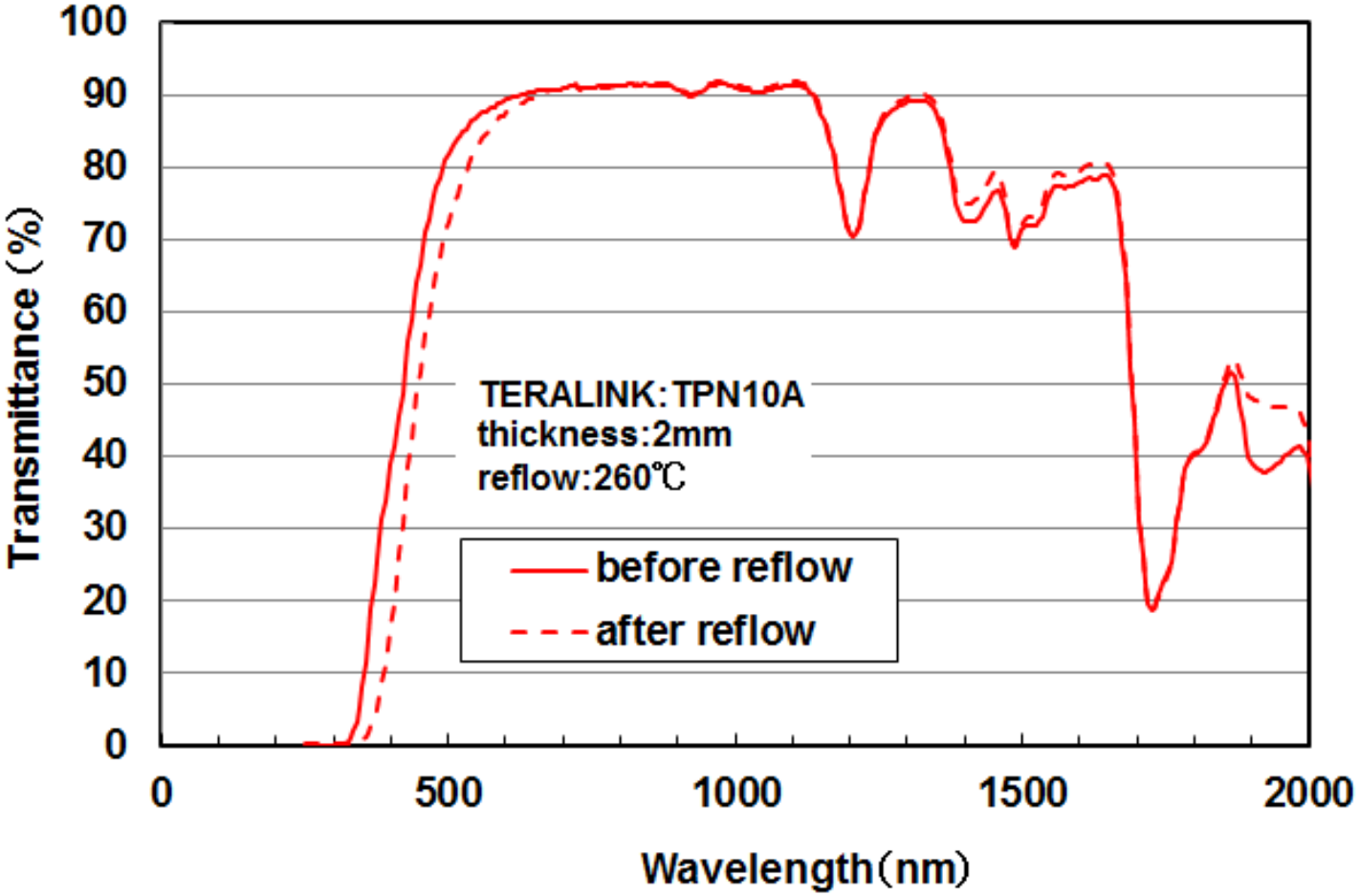


Transmittance spectrum



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

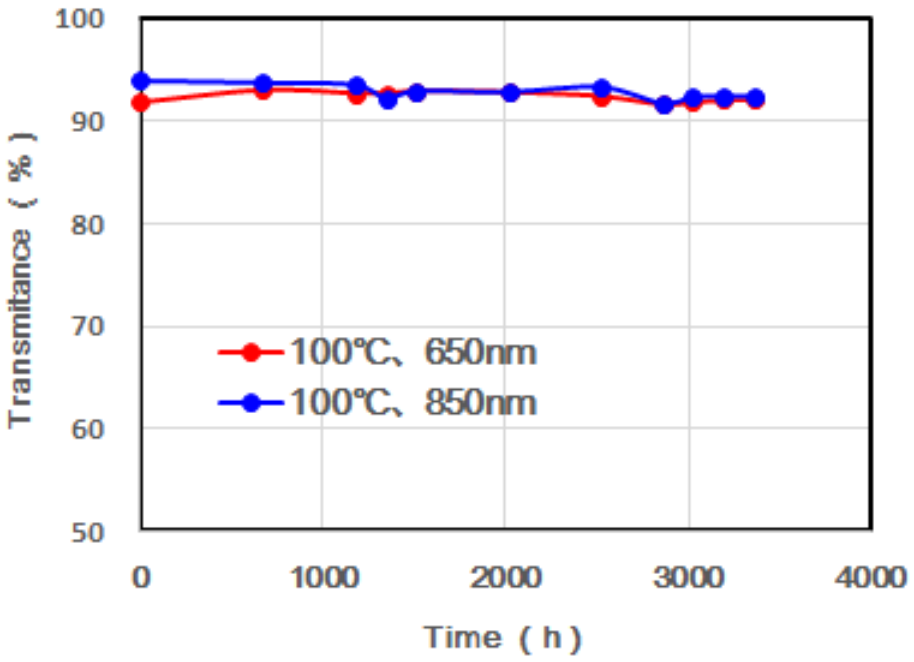
Effect of reflow on transmittance



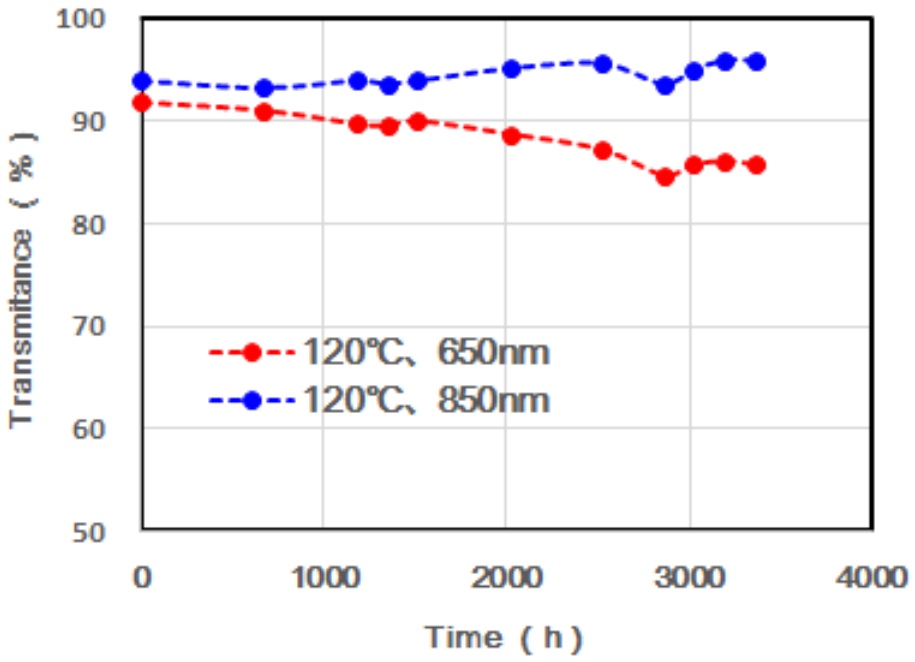
Transmittance spectrum remains virtually unchanged above 650nm

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℃

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

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!

THANK YOU!

Sumitomo Electric Fine Polymer, Inc.
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June 2016