High Speed Transmission Characteristics on Glass interposer for High Performance Computing

Dai Nippon Printing co, ltd

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DNP

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OUTLINE

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I. Introduction

II. Concept of Development

III. High frequency characteristics of glass interposer

IV. Modeling high speed transmission for 2.5D interposer

V. Summary

2.1D Glass Interposer for HPC

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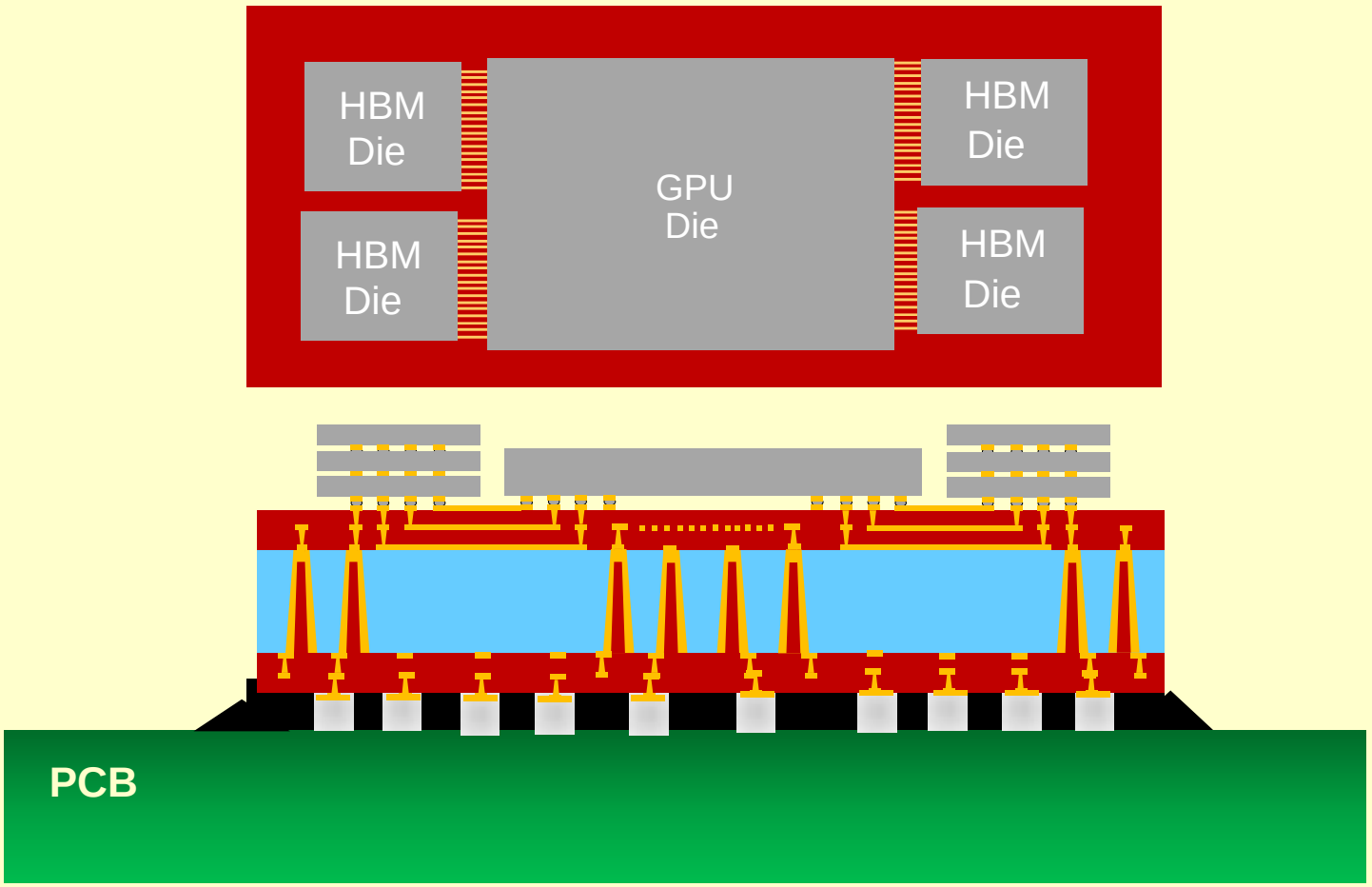

1. Fine pitch for wiring L/S=0.75/0.75um -2/2um
2. Double side low loss polymer laminate RDL
3. Large panel level fabrication

Process flow

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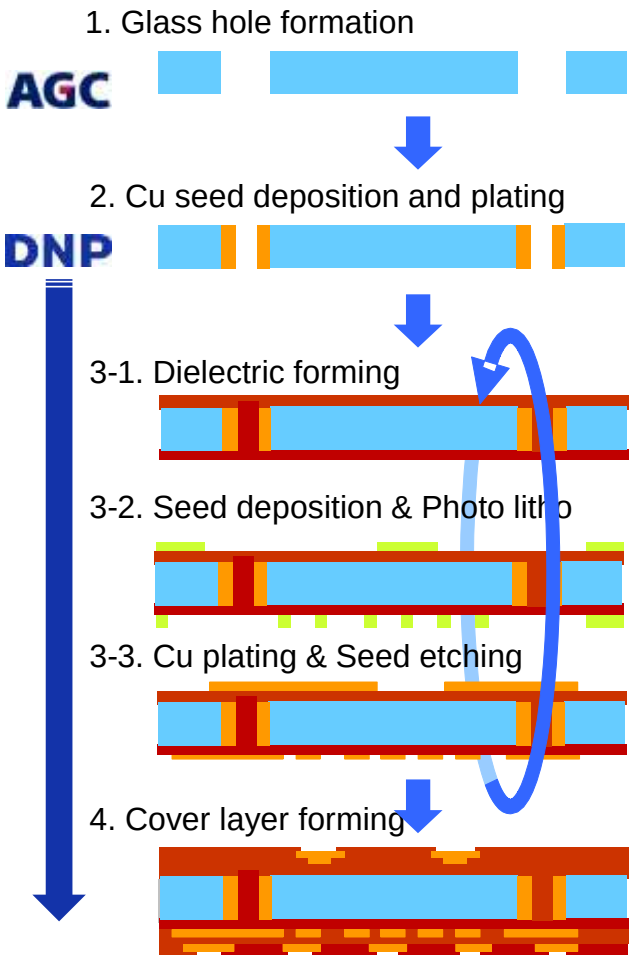
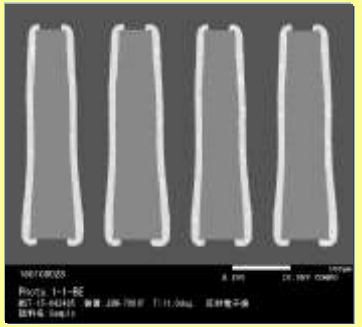


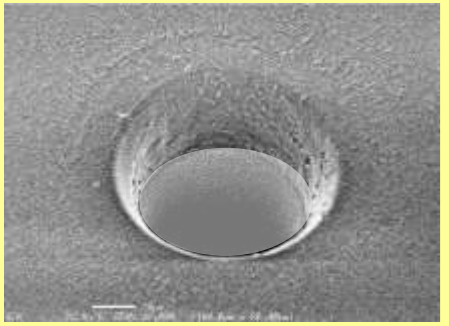
Features of GiP

Filled TGV

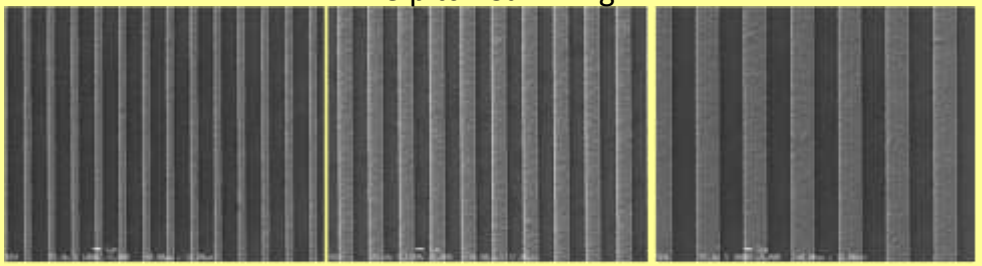
Conformal TGV



Micro Via



Fine pitch Cu wiring



L/S=1/2 L/S=2/2 L/S=3/3

High frequency characteristics of Transmission line with TGV

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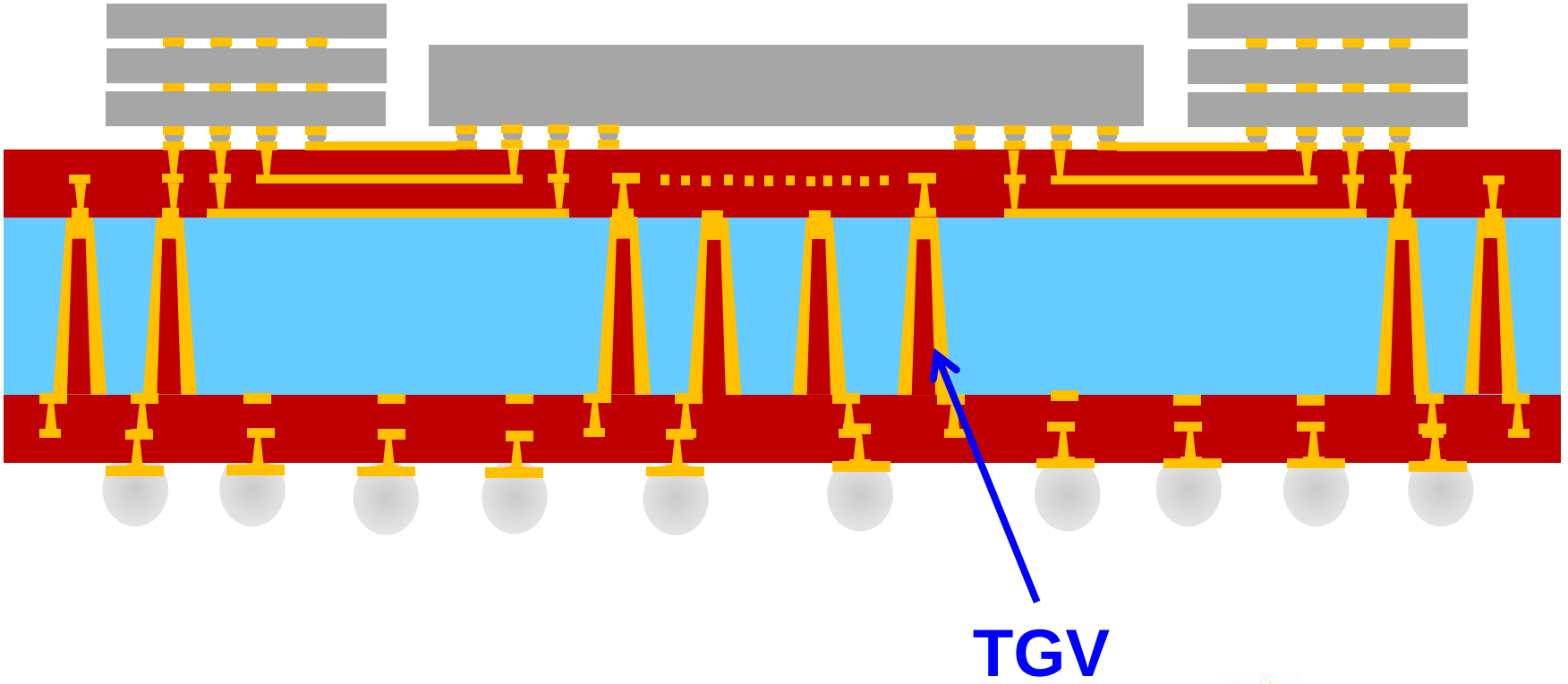
2.1D Glass Interposer



Measurement result of transmission line with TGV

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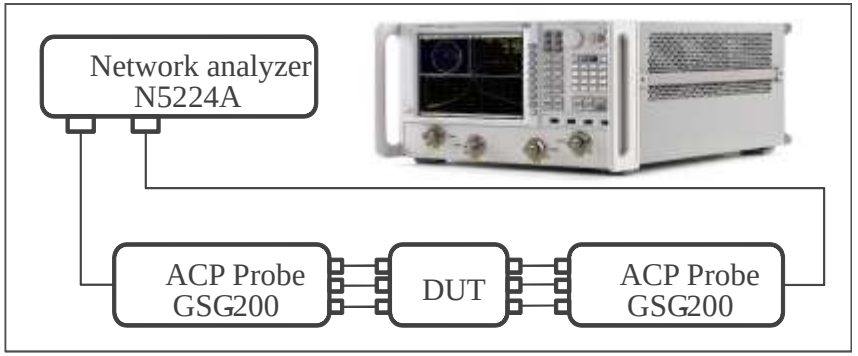
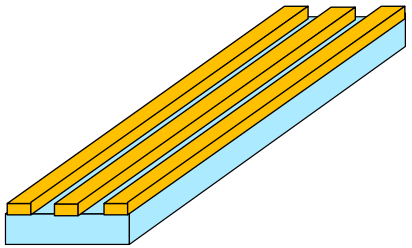
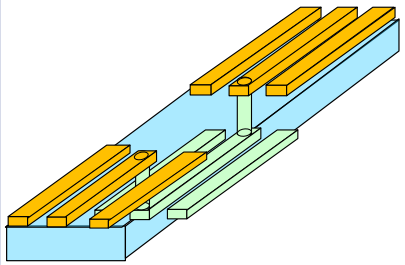
S-parameter measurement setup



Compare Measurement Data



CPW(co-planer wave guide)



CPW(co-planer wave guide)+TGV

Measurement result of transmission line with TGV

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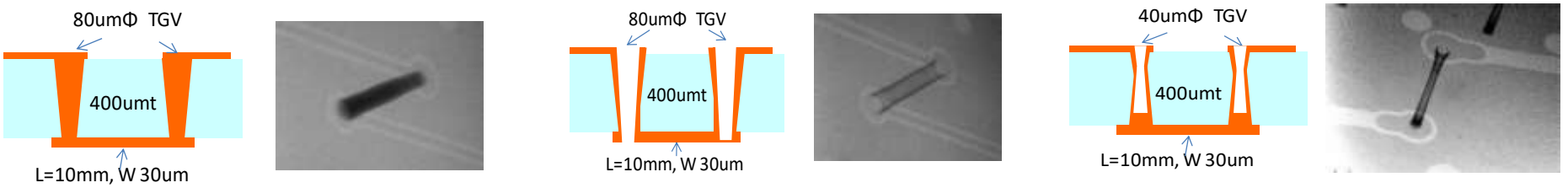
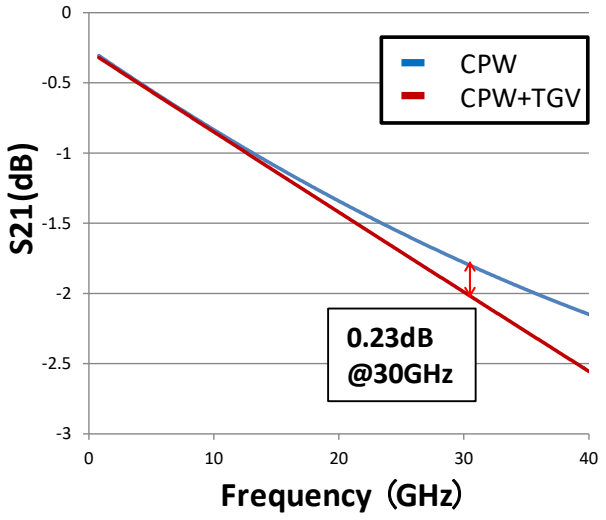
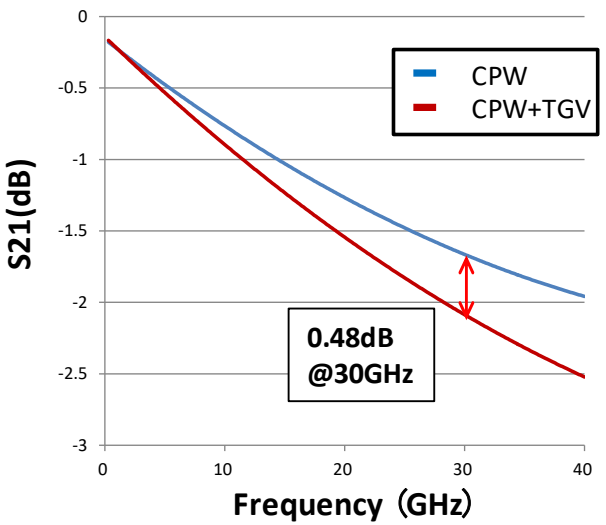


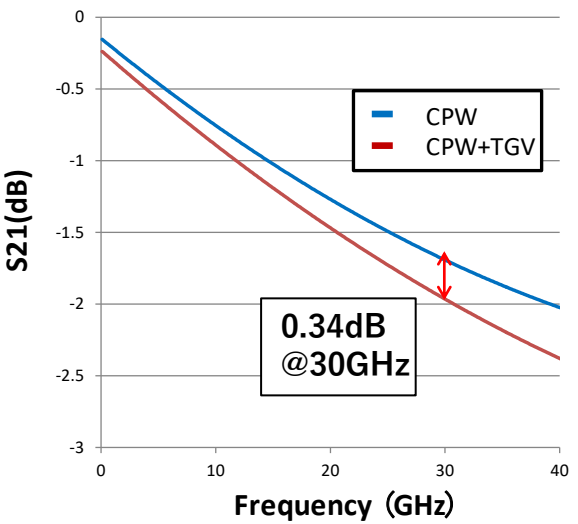
Filled Type



Conformal Type



Partial fill Type



Filled Type < **Partial fill Type** < **Conformal Type**

There are difference, but loss are very lower than surface wiring loss.

Measurement result of transmission line with TGV

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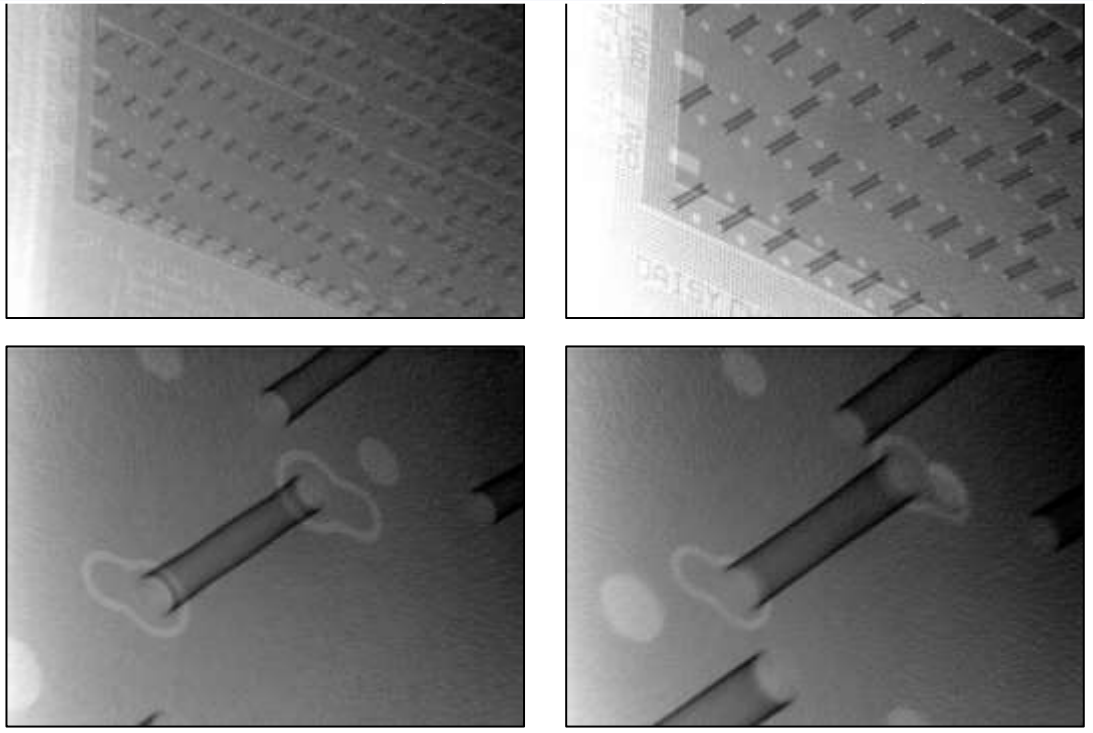
Glass material property

	Dielectric constant	Dielectric loss
Alkali-free Glass (EN-A1)	5.8	0.006@10GHz
Synthetic fused Quartz Glass (AQ)	3.8	0.0002@10GHz



Measurement result of transmission line with TGV

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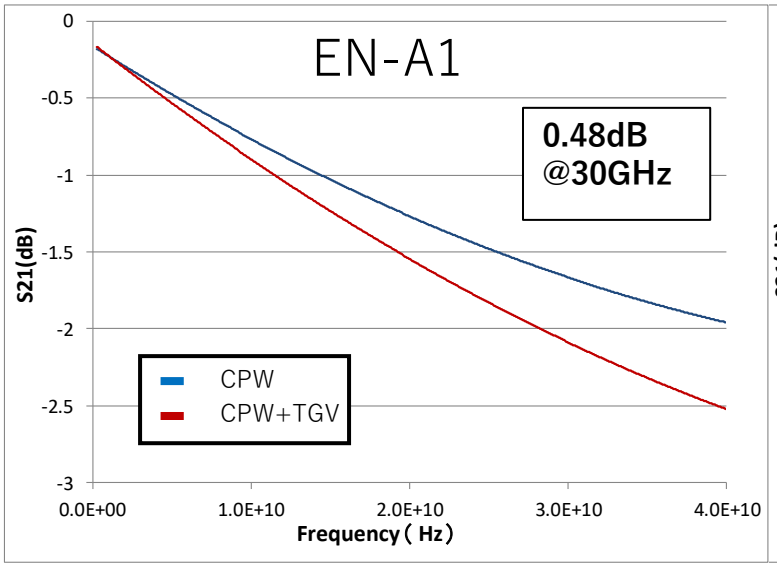

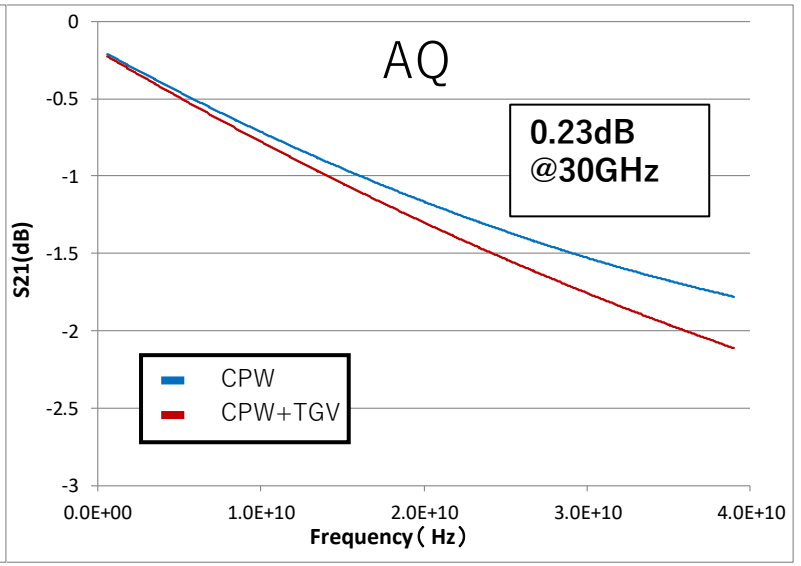

Loss of via portion

	S21 difference
Alkali-free Glass (EN-A1)	0.48dB@30GHz
Synthetic fused Quartz Glass (AQ)	0.23dB@30GHz

Measurement result of transmission line with buildup layers

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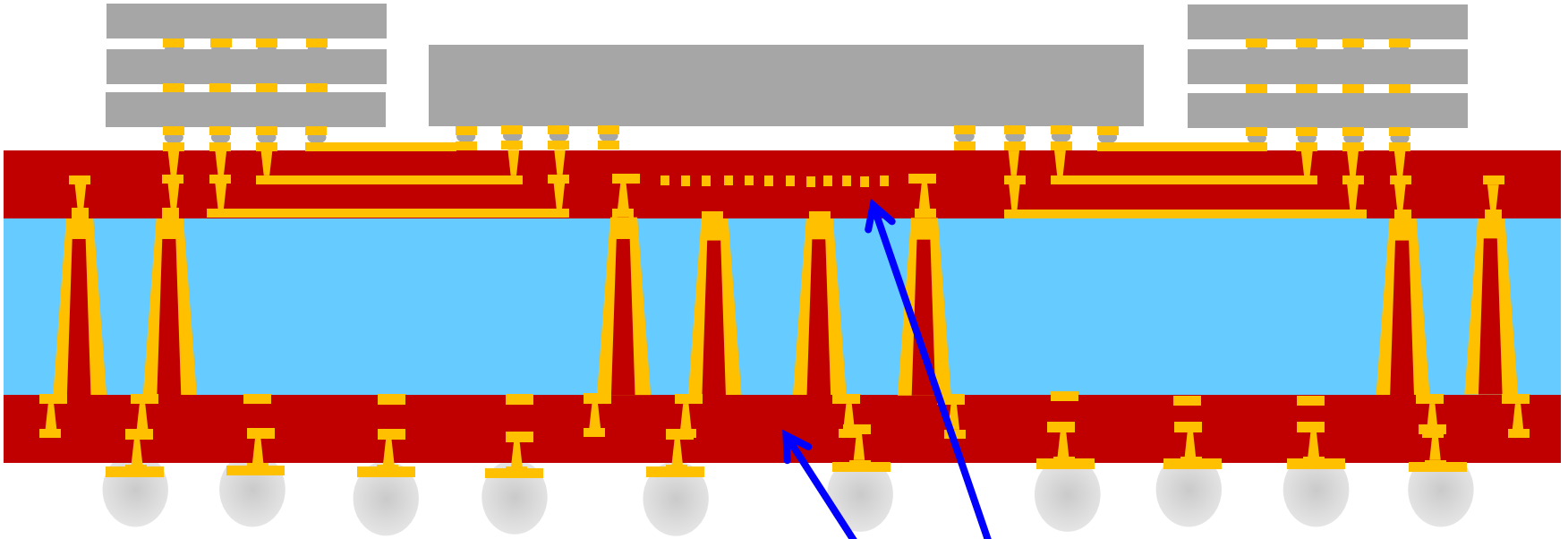
2.1D Glass Interposer



Dielectric polymer material

Measurement result of transmission line with build-up layers

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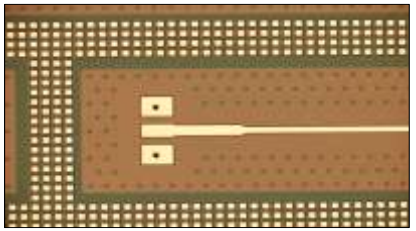
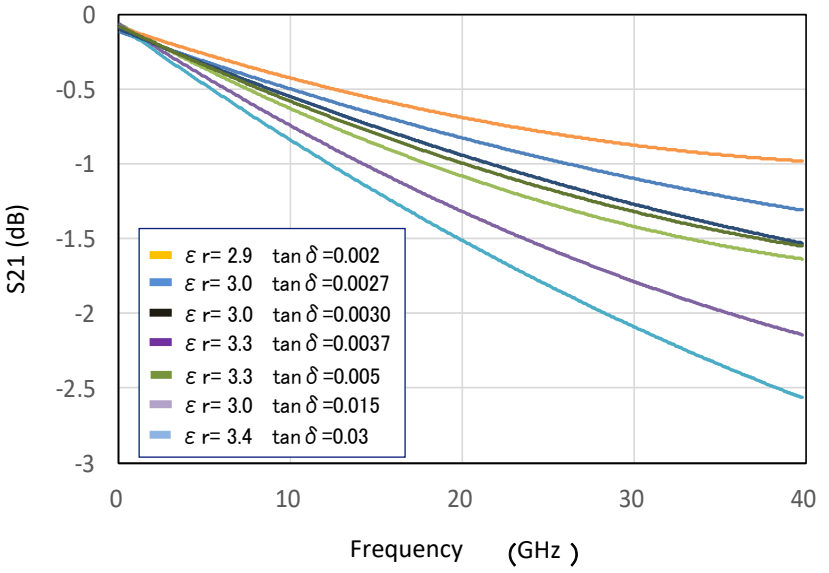
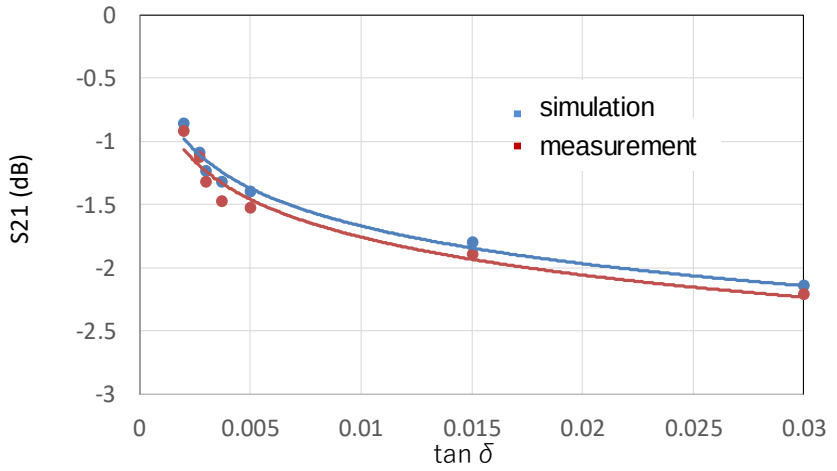


Micro strip line structure

W=60um L=10mm





Measurement result of transmission line with buildup layers

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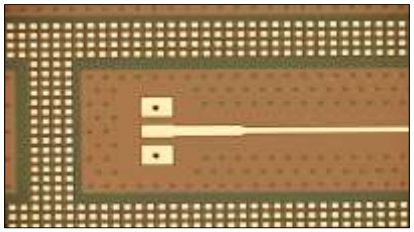
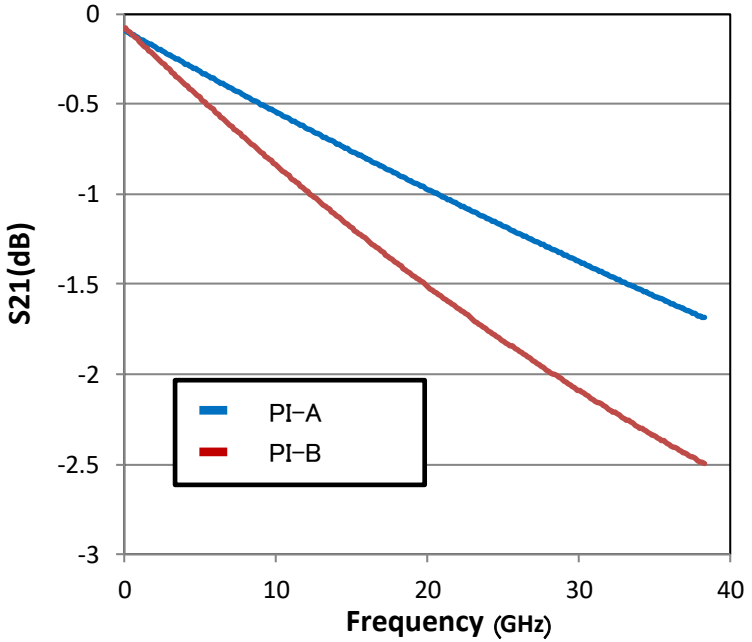
	Dielectric polymer	Er	Tanδ	Insertion loss(dB)
PI-A	Low loss polymer	3.0	0.005 @10GHz	-1.40 @30GHz
PI-B	ConventionalPolymer	3.4	0.03 @10GHz	-2.14 @30GHz



Micro strip line structure

W=60um L=10mm



Measurement result of transmission line with buildup layers

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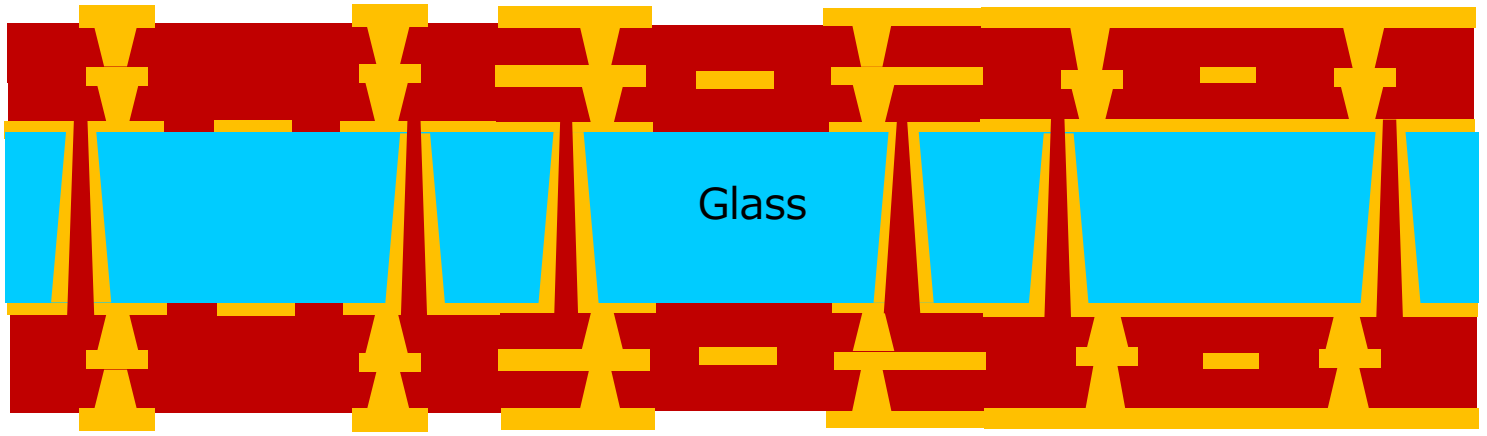
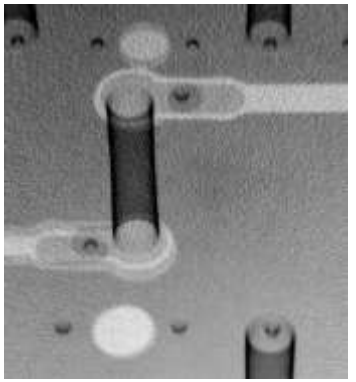
Demonstration of 3 layer transmission line structure TEG

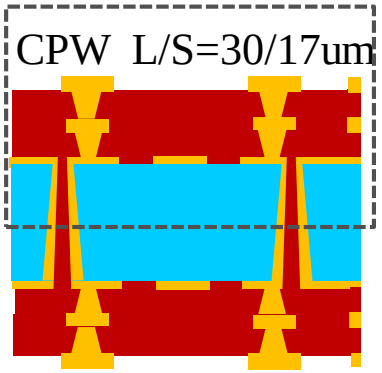
CPW L/S=30/17um CPW L/S=30/13um Strip L=20um

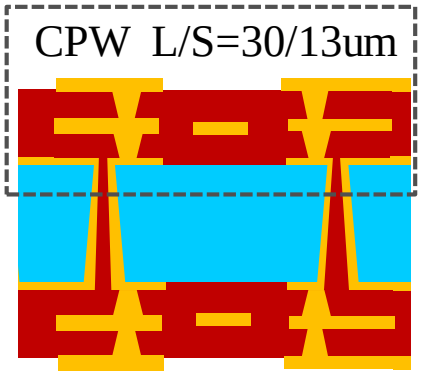


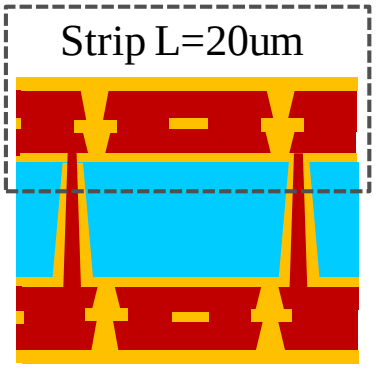


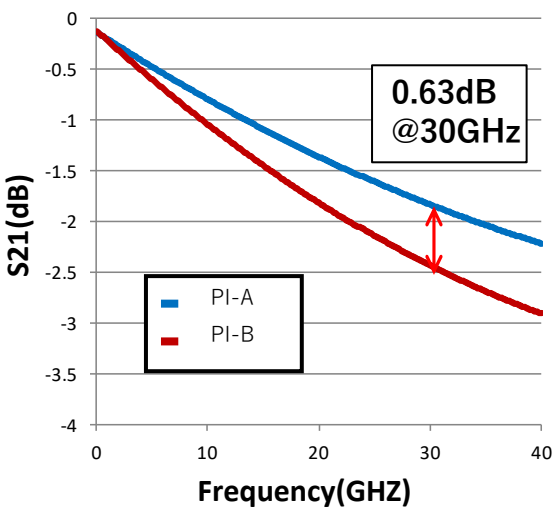
Measurement result of transmission line with buildup layers

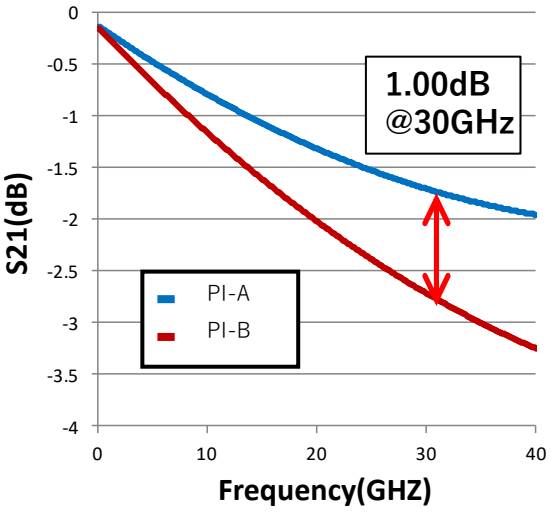
DNP

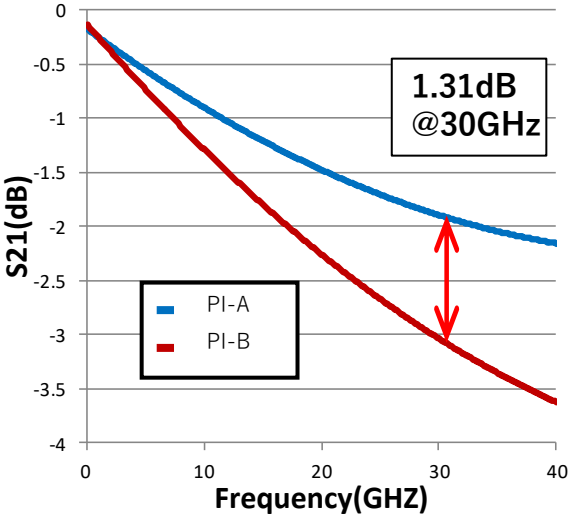












CPW on Glass makes small differential

Modeling high frequency transmission

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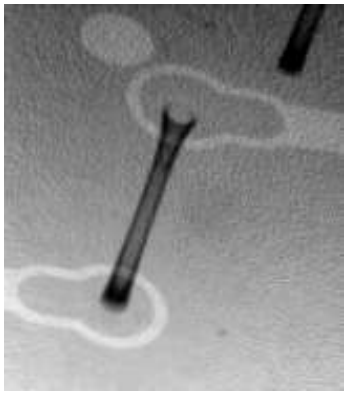
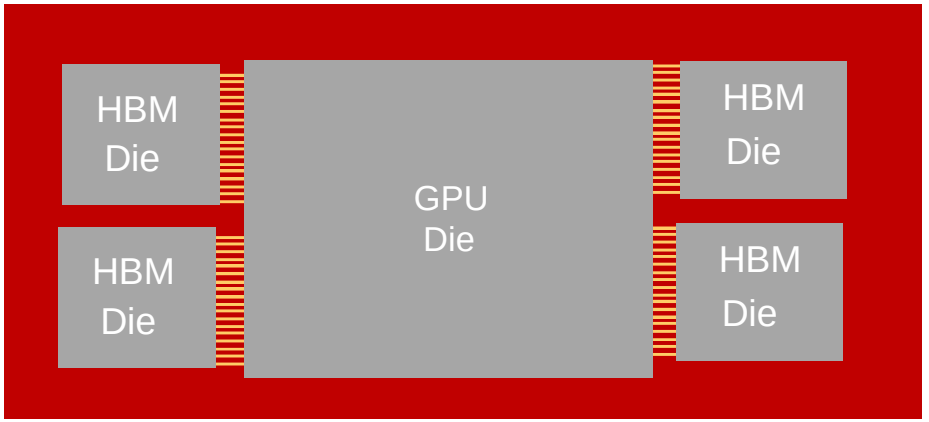
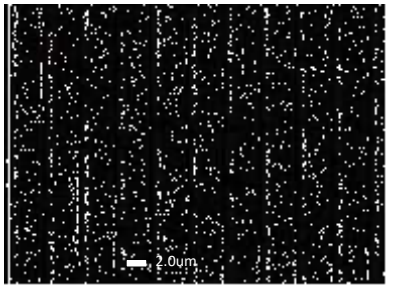
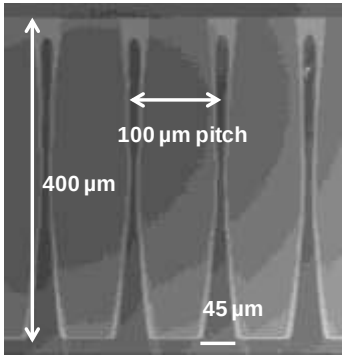
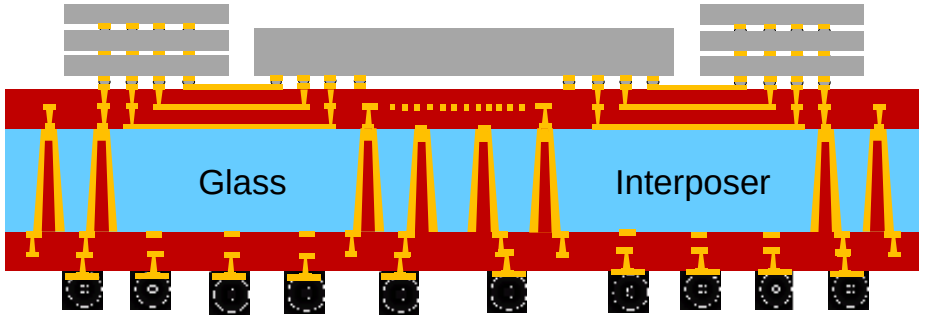
2.1D Glass Interposer

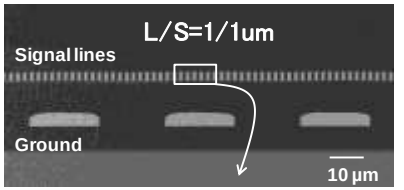


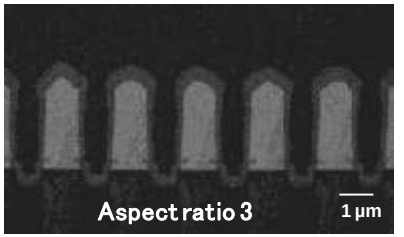












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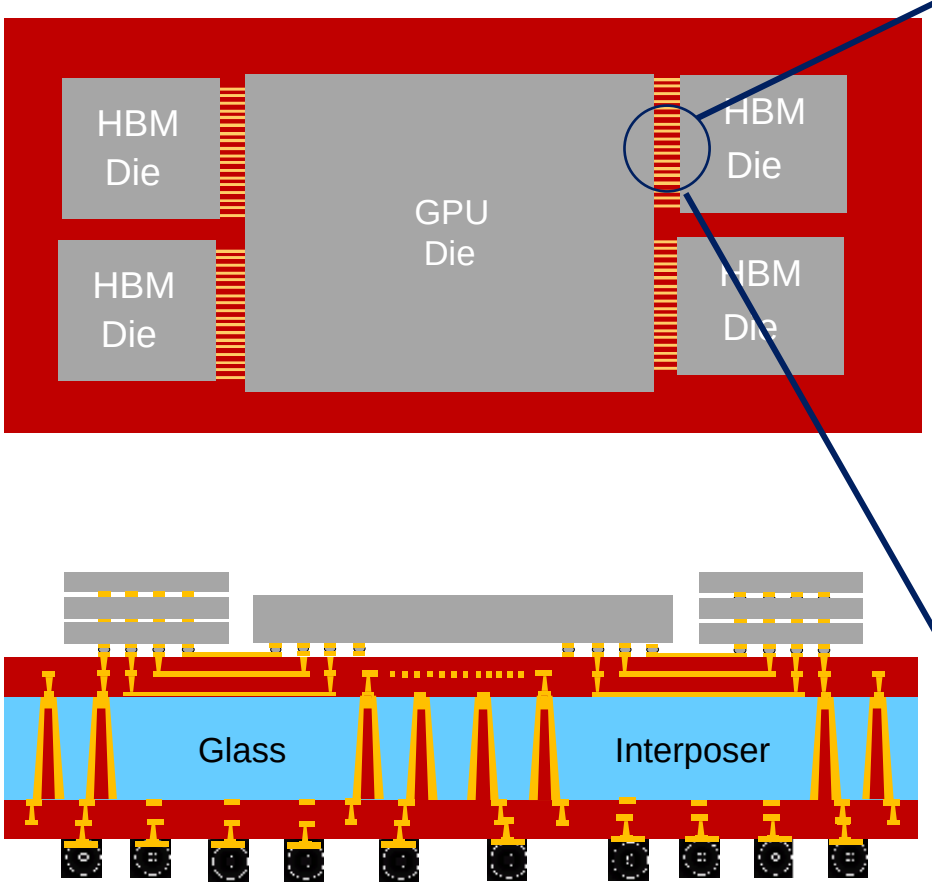
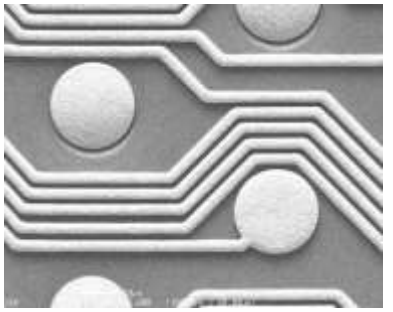
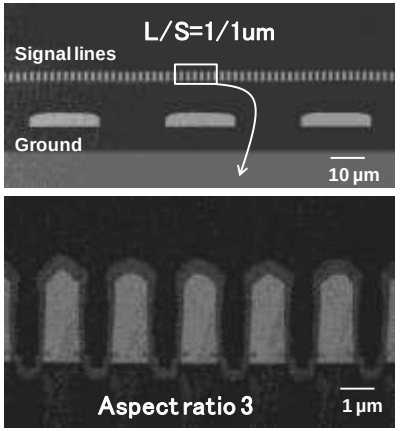


Limitation distribution
Length pad to pad >5mm



Limitation cross section area of fine wiring



L/S smaller than 2/2
Length>5mm → **Conductive loss will be large** → **Need low loss dielectric structure**

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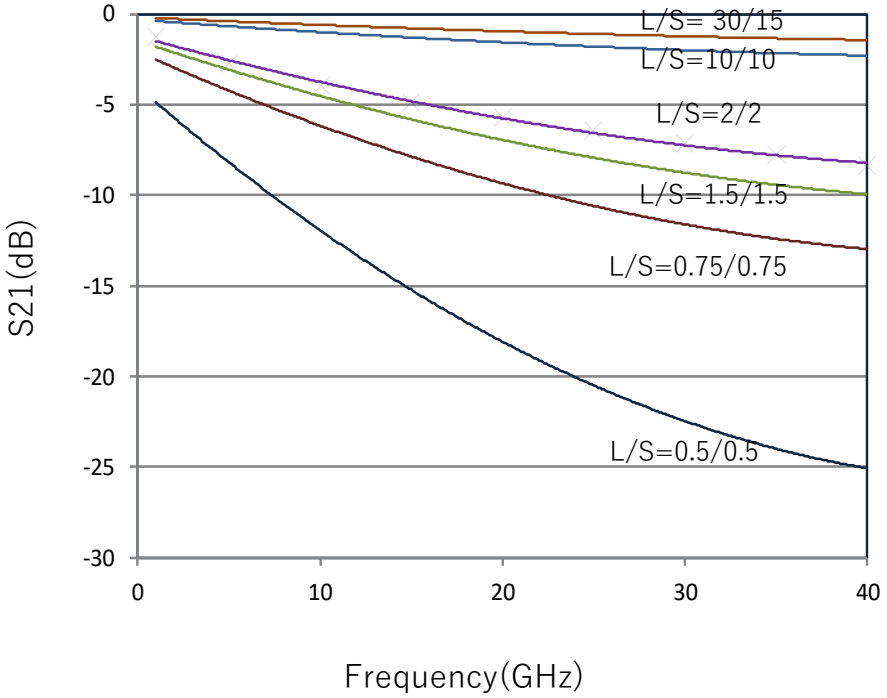
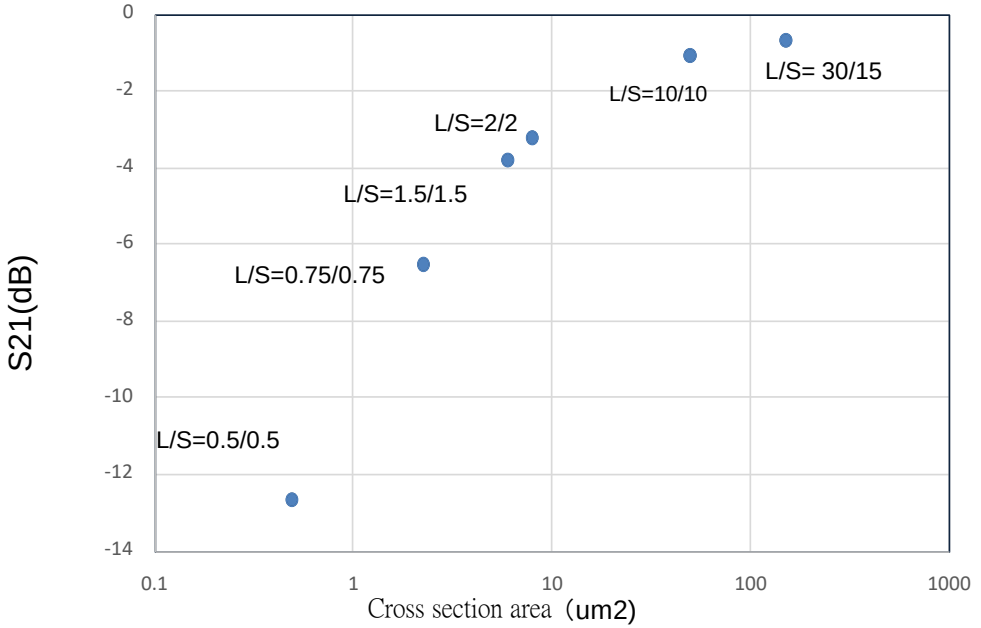
Insertion loss depend on trace width





Insertion loss are large under L/S=1/1

High frequency transmission characteristics

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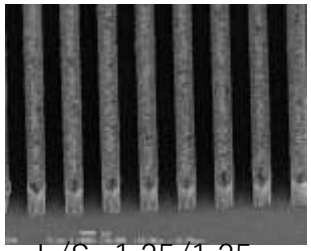
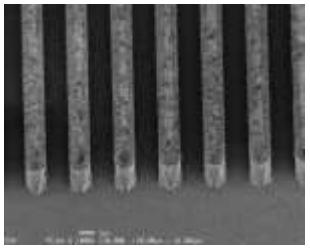
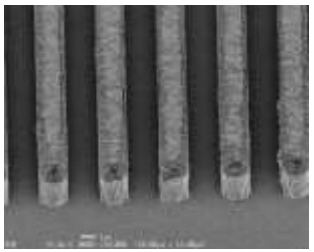
Measurement result of fine wiring CPW



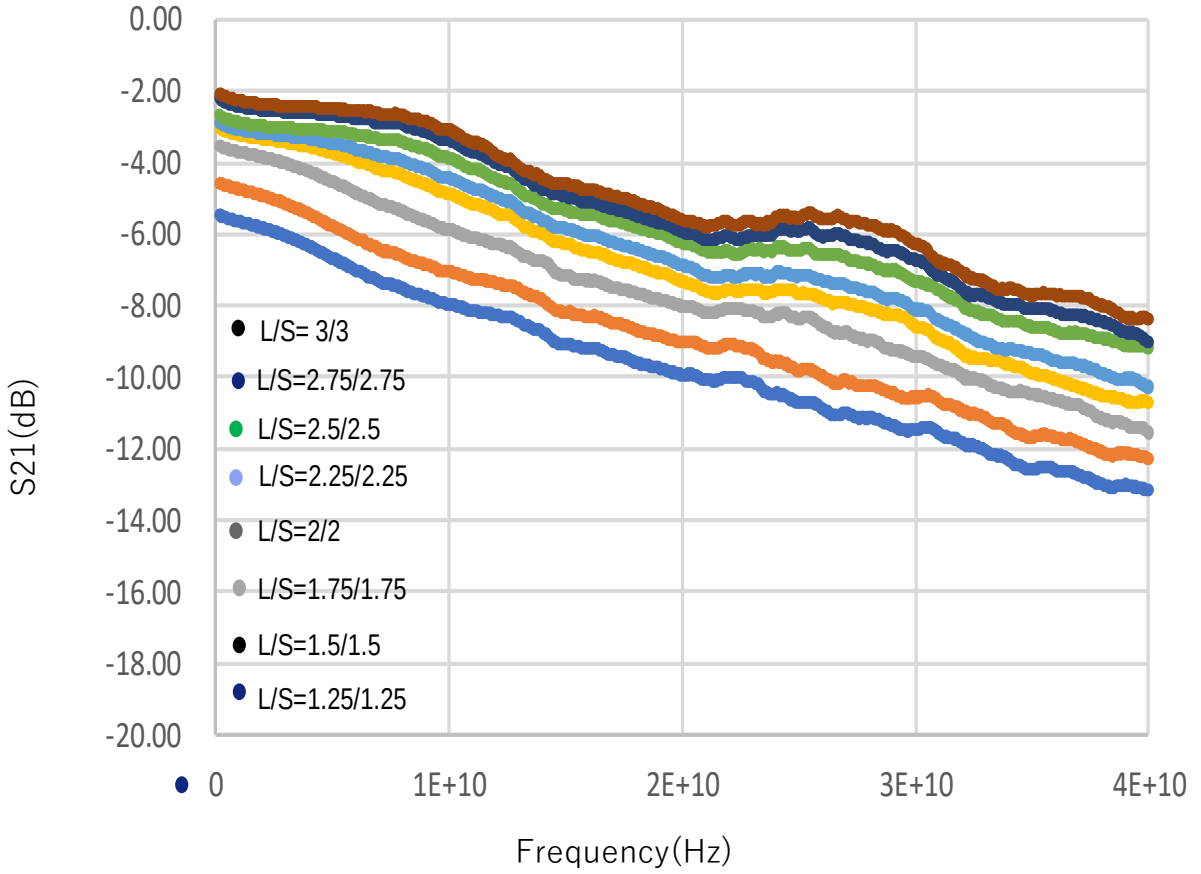
L/S=1.25/1.25um



L/S=1.5/1.5um



L/S=2.0/2.0um



Insertion loss are strongly depend on line width

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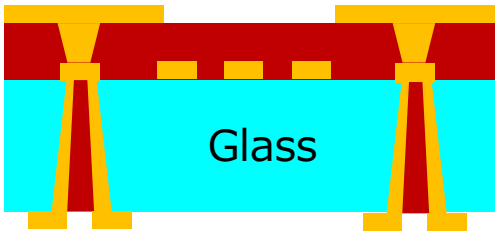
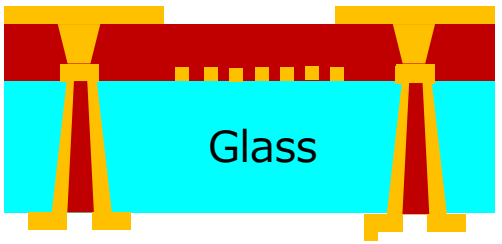
Impact of dielectric material

L/S=30/15um



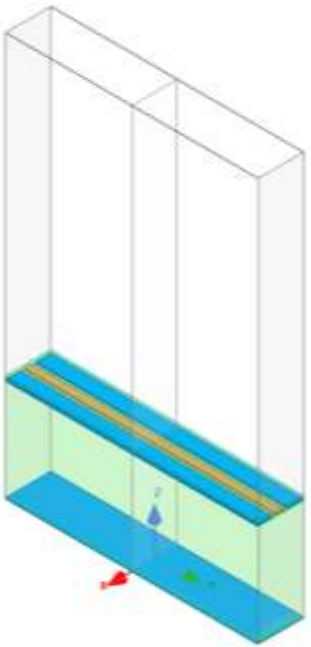
L/S=0.5/0.5um



L/S=0.5/0.5-30/15um,

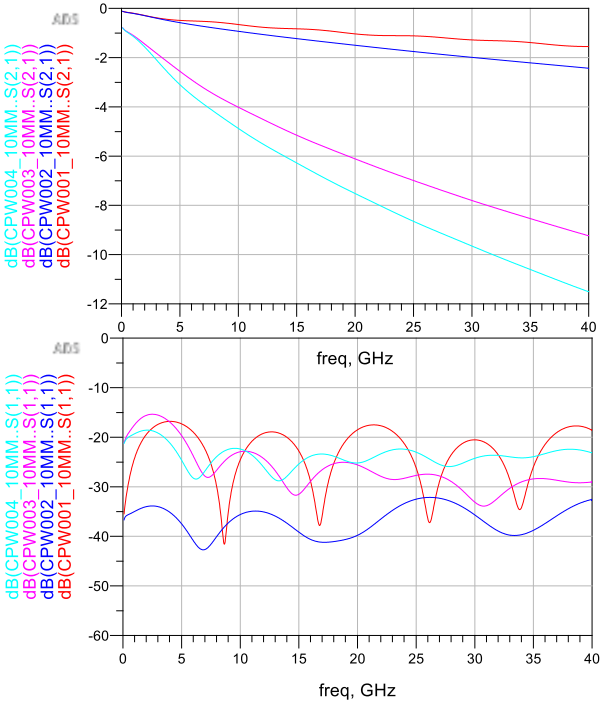
10Gbps 10㎜ length

model(001)



2.5D simulation

Wiring length 10mm port



Modeling high speed transmission

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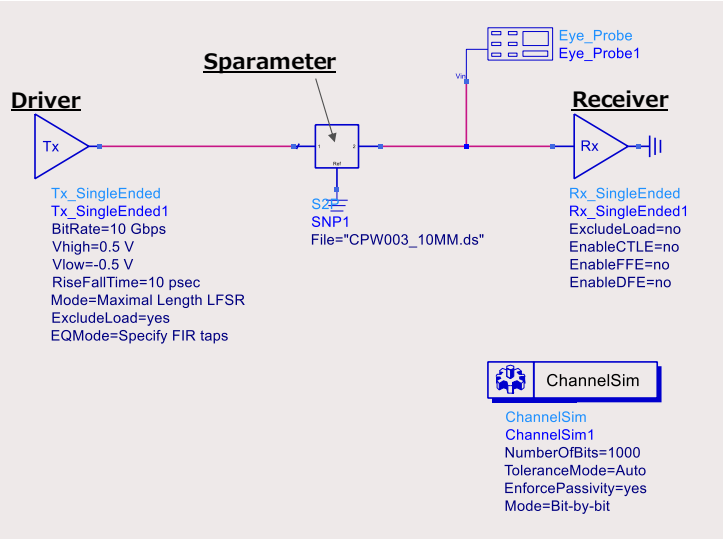
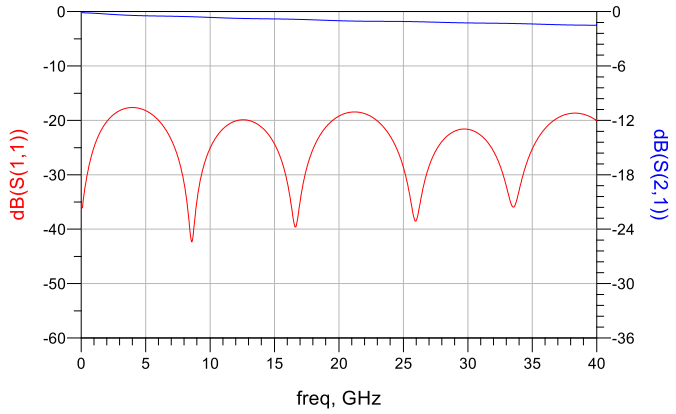
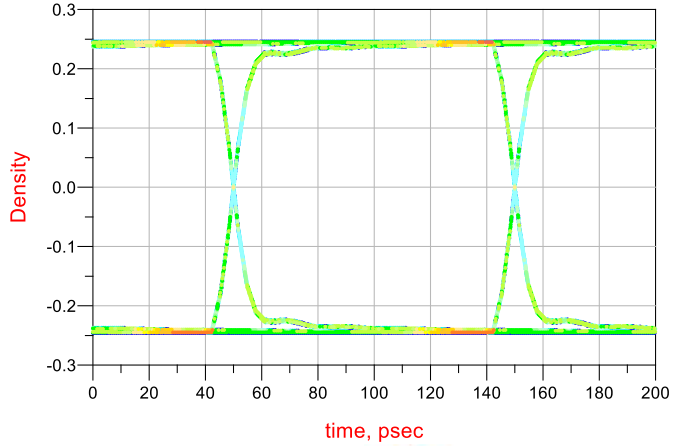
【Eye diagram anlysis】







Modeling high speed transmission

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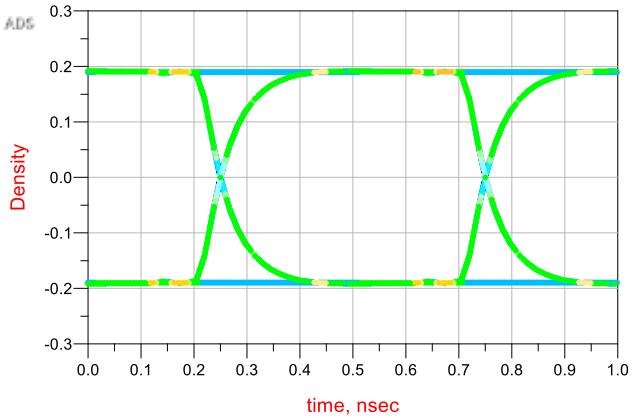
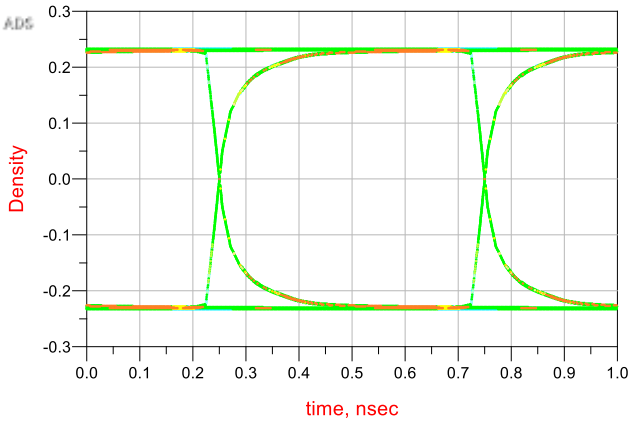
2Gbps

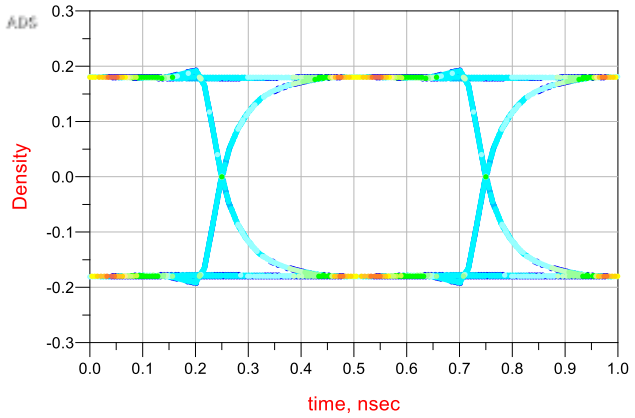
L/S=0.5/0.5um



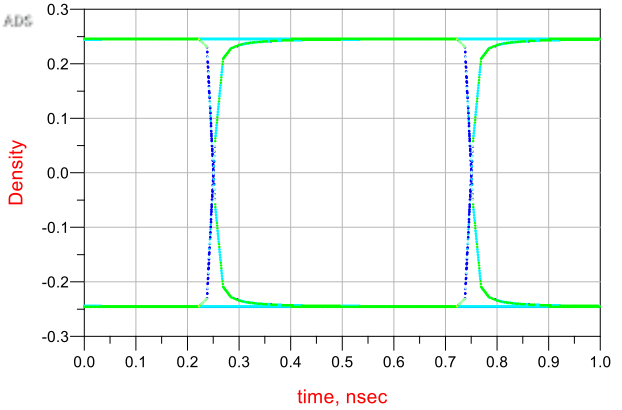
L/S=2.0/2.0um



L/S=0.75/0.75um



L/S=10/10um

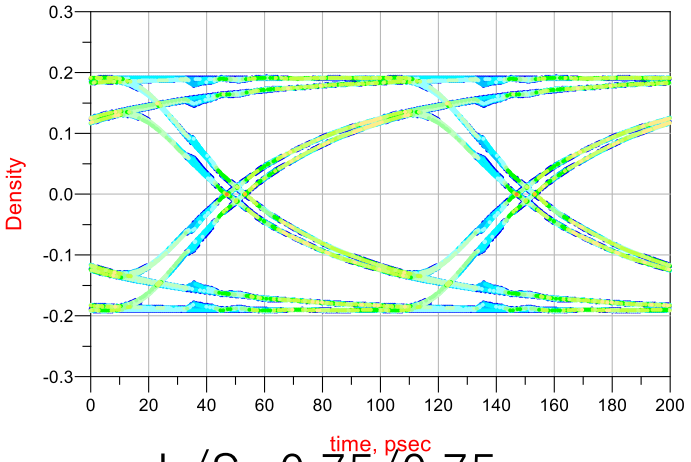


Modeling high speed transmission

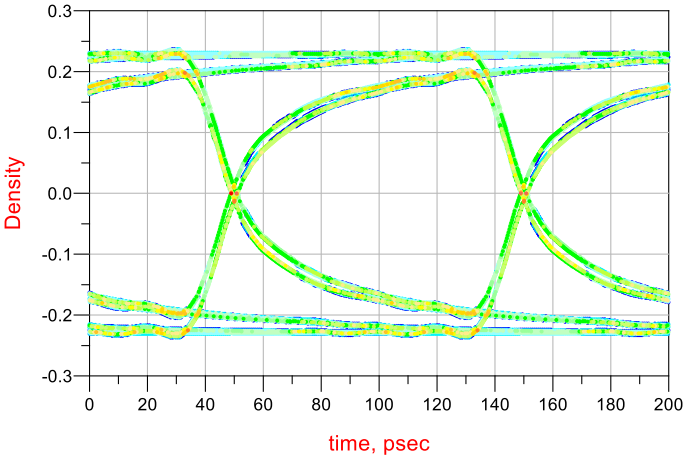
DNP

10Gbps

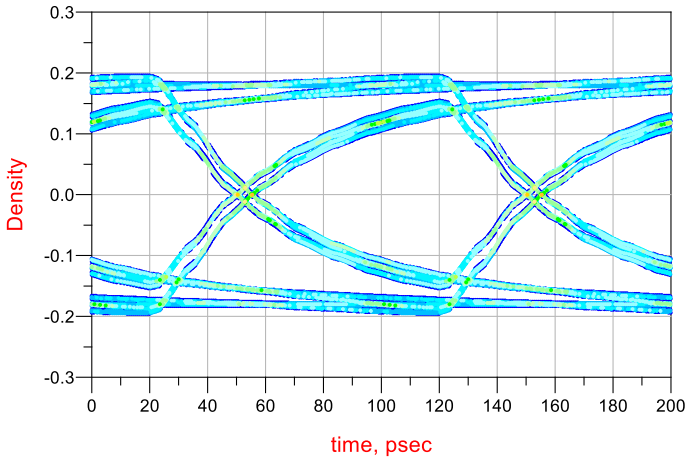
L/S=0.5/0.5um



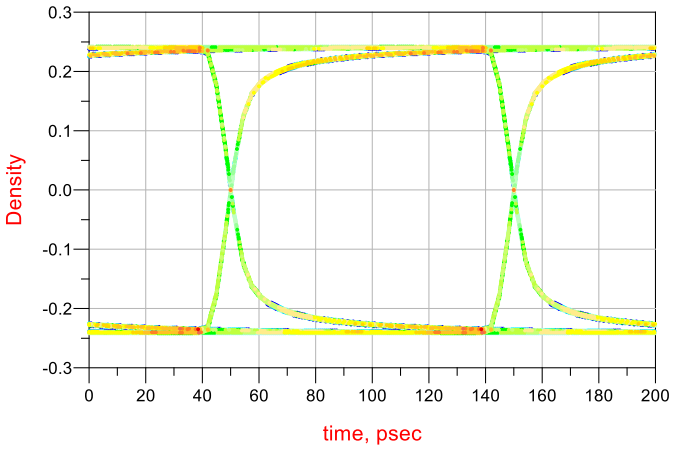
L/S=2.0/2.0um



L/S=0.75/0.75um



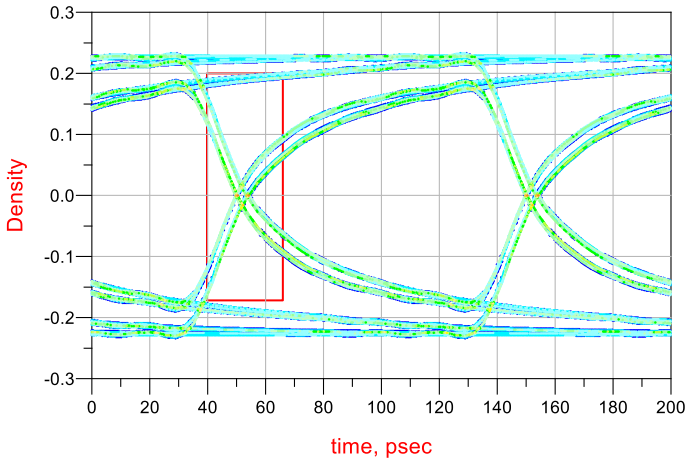
L/S=10/10um



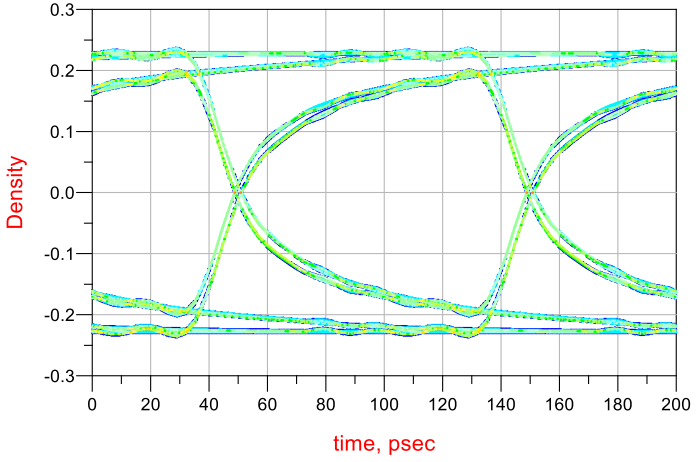
Modeling high speed transmission

DNP

L/S=1.5/1.5 um tanδ=0.03 dielectrics



L/S=1.5/1.5um tanδ=0.005 dielectrics

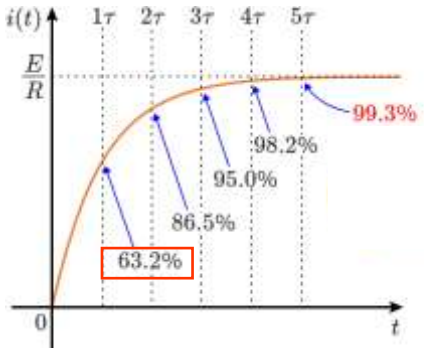


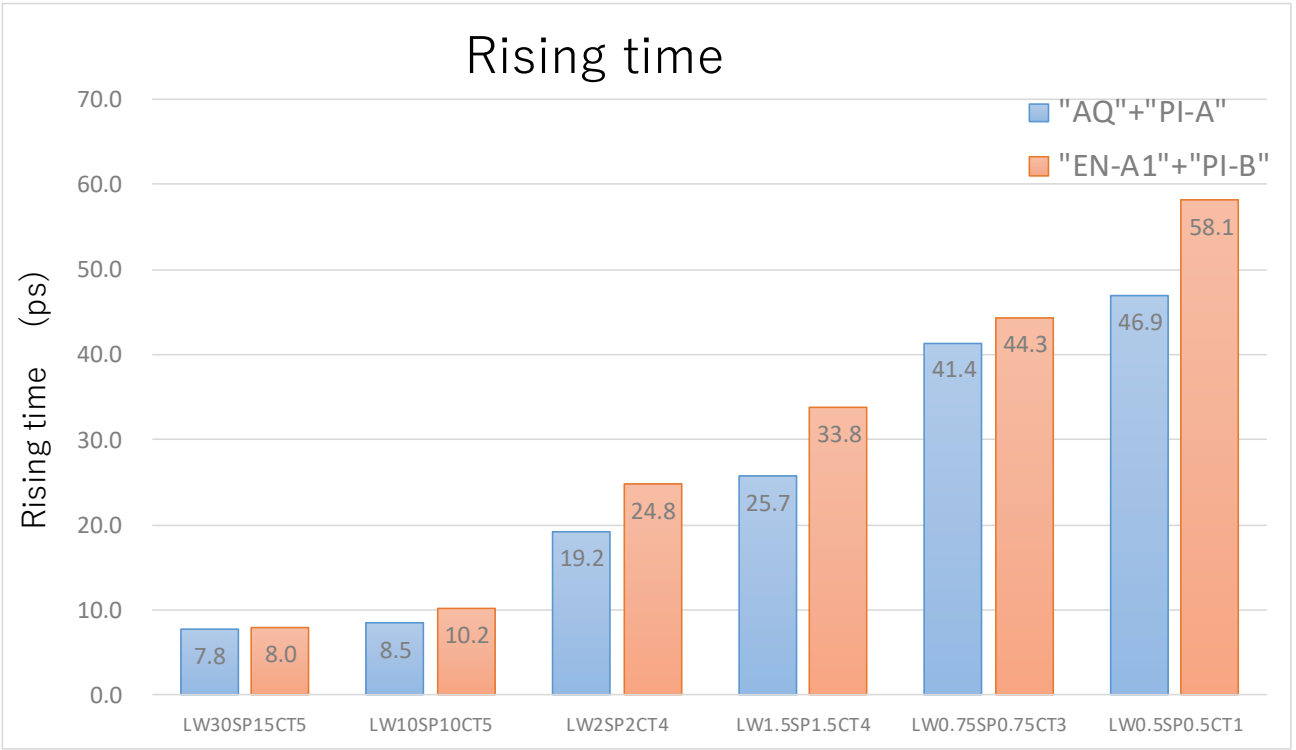
Model	Eye height(V)	Rising time(psec)
CPW tanδ=0.005 dielectrics	0.30	25.7
CPW tanδ=0.03 dielectrics	0.27	33.8

Modeling high speed transmission

DNP

Rising time





L/S= 30/15um

L/S= 10/10um

L/S= 2.0/2.0um

L/S= 1.5/1.5um

L/S= 0.75/0.75um

L/S= 0.5/0.5um

Summary

- Three types of TGV were demonstrated and measured high frequency characteristics. All three types, TGV itself are very low loss.
- Quartz glass has a very small insertion loss of -0.23dB at 30GHz. Quartz glass has small loss comparing with the alkali-free glass.
- Low loss dielectrics synthesized and measured for high frequency transmission characteristics.
- Modeling 2.1D transmission structure, Excellent transmission characteristics obtain fine pitch area using low loss dielectrics.