NASDAQ
LWLG

LIGHTWAVELOGIC®

From Materials to Silicon Photonics PDKs: Scaling Foundry Platforms to 400G and Beyond

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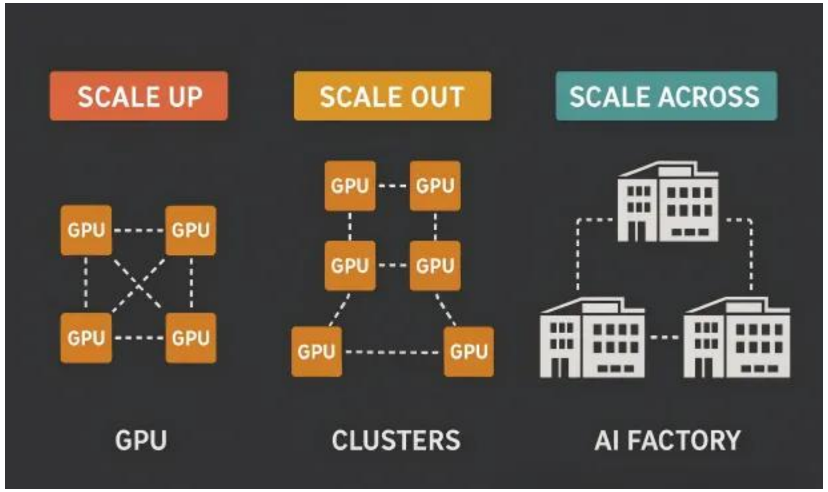
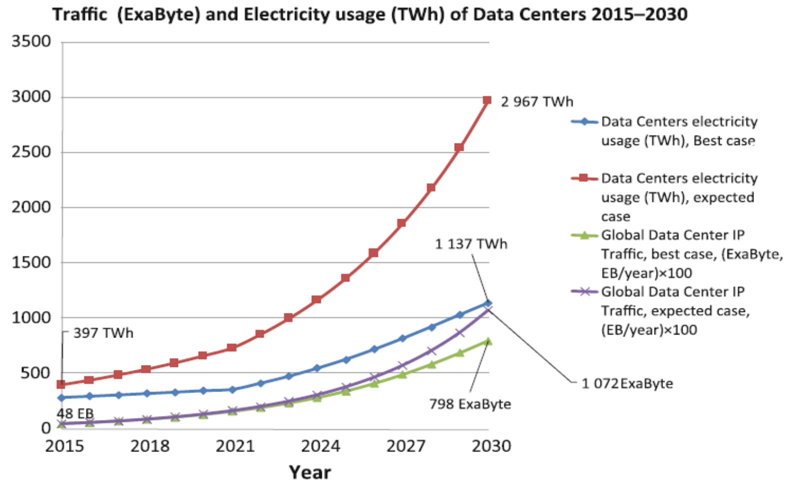
PIC International, Brussels – April 22, 2026

The Challenge of Powering AI: Density, Power, Reliability





T. Sentaurious et al, *Rethinking Climate and Energy Policies,* Springer (2017)

Sources:
https://epoch.ai/gradient-updates/how-much-energy-does-chatgpt-use

https://www.cnet.com/tech/services-and-software/your-ai-videos-use-way-more-energy-than-chatbots-its-a-big-problem/

Explosive growth in data traffic requires advanced optical modulators:

- Denser Integration
- Higher Bandwidth
- Reduced Driving Voltage
- Reduced Insertion Loss
- High Reliability

Possible solutions include enhanced silicon photonics devices:

Inorganic EO Materials

- Thin-Film Lithium Niobate (TFLN), Barium Titanate (BTO), etc.

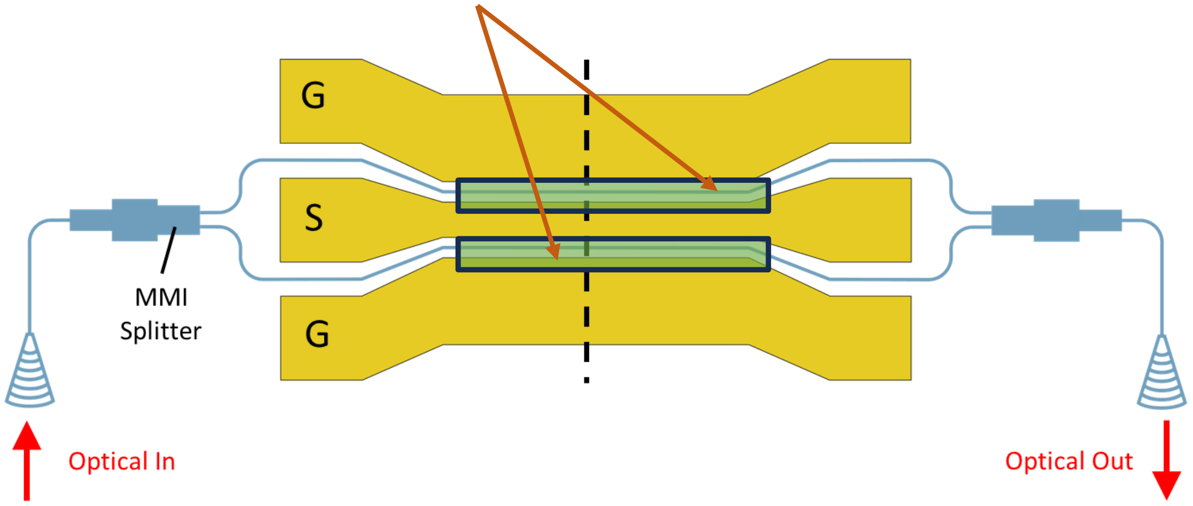
Organic EO Materials

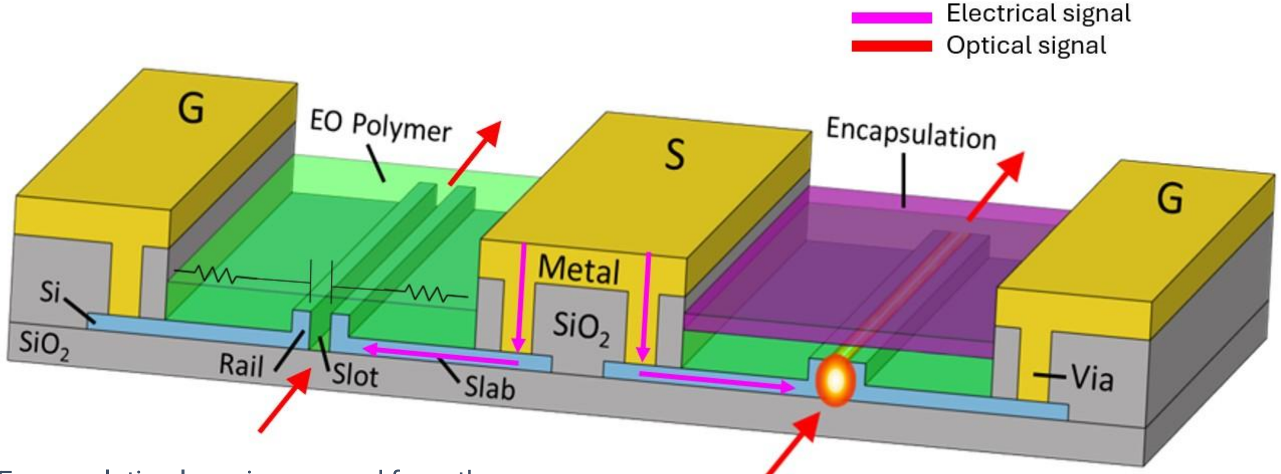
- EO Polymer SOH Modulators

Data Center Power Consumption Continues to Grow Exponentially with AI Connectivity Demands

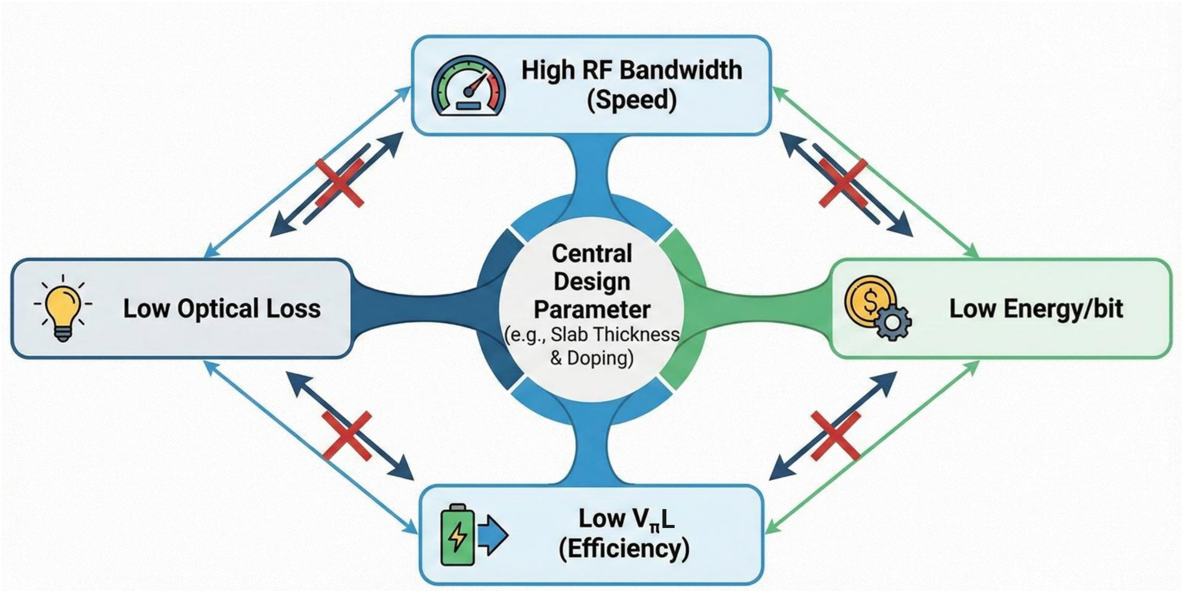
EO Polymer SOH MZI Slot Modulator: Structure

Polymer-coated regions





Encapsulation layer is removed from the left slide here for better slot WG visibility



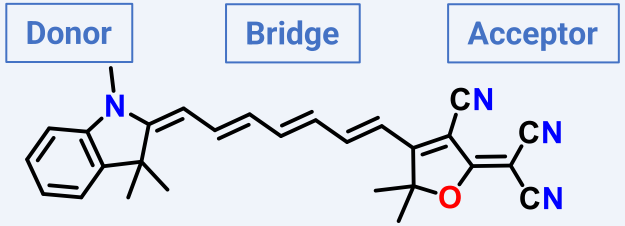
The SOH Advantage:

- Combines the **maturity** of Silicon Photonics with the **strong EO response** of polymers
- Offers significant promise for scalable deployment in the **datacom and telecom spectrum** (O- and C-bands)
- Core technology is **CMOS compatible** and **mass-scalable**

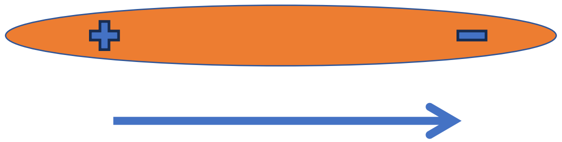
J.A. Drisko et.al. Frontiers in Optics, pp. FM1C-1.Optica Publishing Group (2024)

Electro-Optic (EO) Polymer: Mechanism of Operation

General chromophore structure



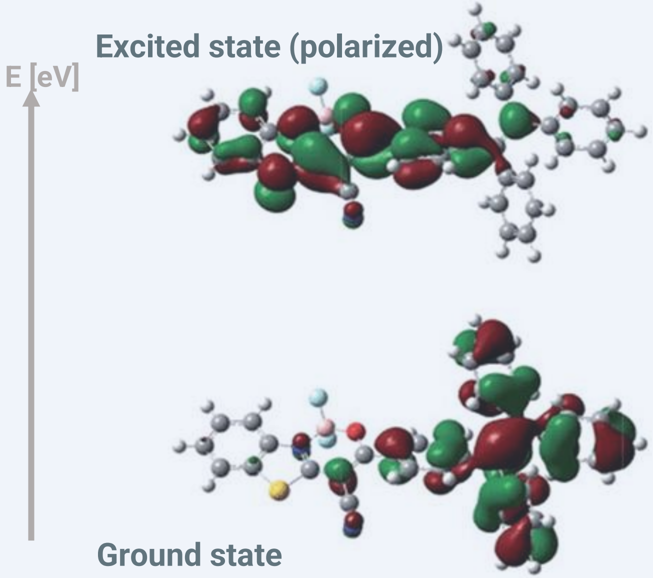
Chromophores are dipolar molecules



Chromophores are aligned in the host polymer through a poling step

Pockels Effect:

- Linear electro-optic effect with THz response frequency
- Refractive index change directly proportional to applied electric field
- Occurs in non-centrosymmetric materials



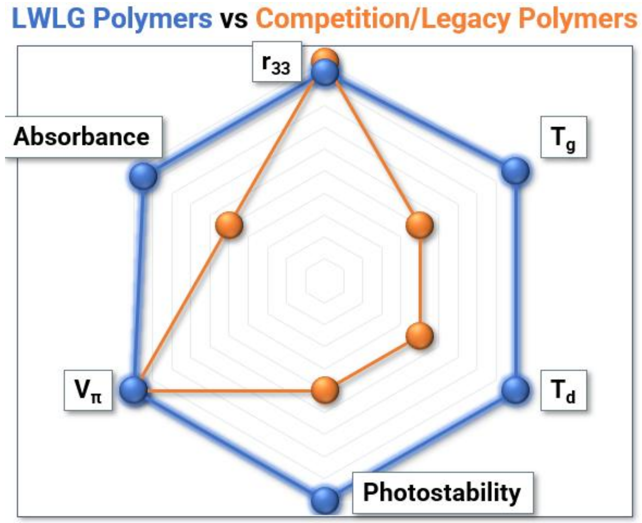
The electric field shifts the electron cloud to the excited-state molecular orbitals. This alters the refractive index of the electro-optic material, which in turn causes a phase change to any transiting optical signal.

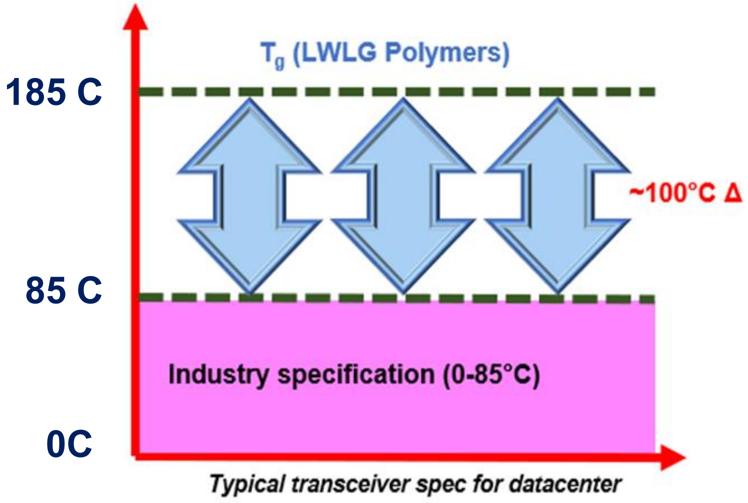
EO Polymer’s Refractive Index Changes Proportional to Applied Field (Pockels Effect)

RSC Adv.. 7. 1348-1356. 10.1039/C6RA25871A.

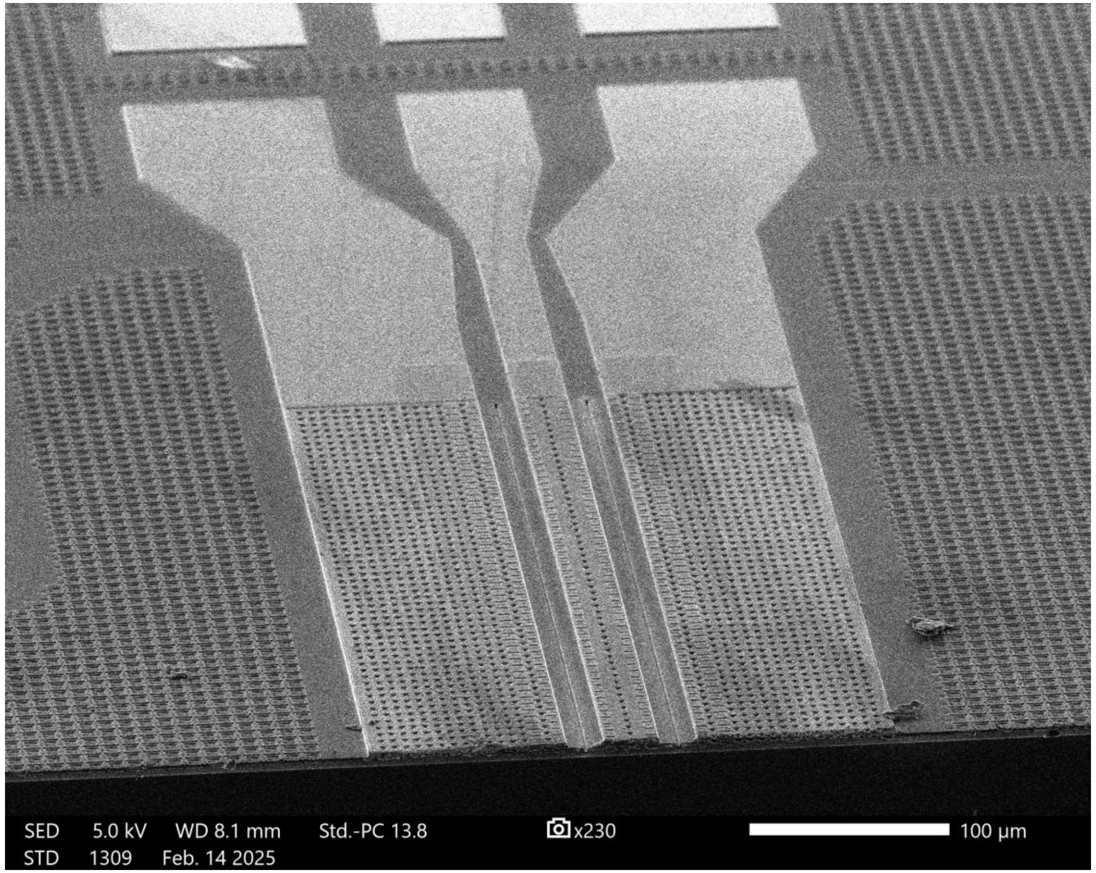
LWLG EO Polymers: Characteristics → Benefits

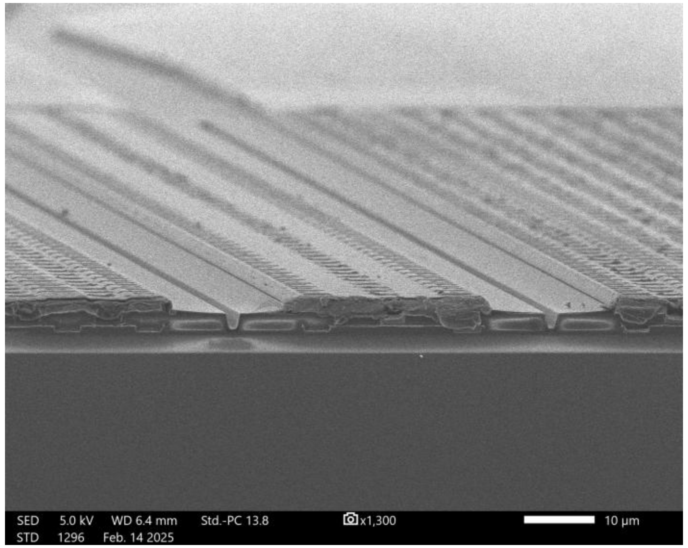
High electro-optic coefficient (r_{33} > 200 pm/V)	→ Low V_{pp} (low $V_\pi \cdot L < 1\ V$ mm) → Small, highly integratable devices (< 1mm)
Easy integration with SiPh device fabrication	→ Leverages SiPh device eco-system → Low cost
Intrinsic modulation speed in the THz range	→ High BW SiPh devices possible (> 100 GHz)
Low dielectric constant	→ Optical and RF speed matched in device
High T_g	→ Post Poling Process Temps up to 185 °C Operating temperatures > 85 °C

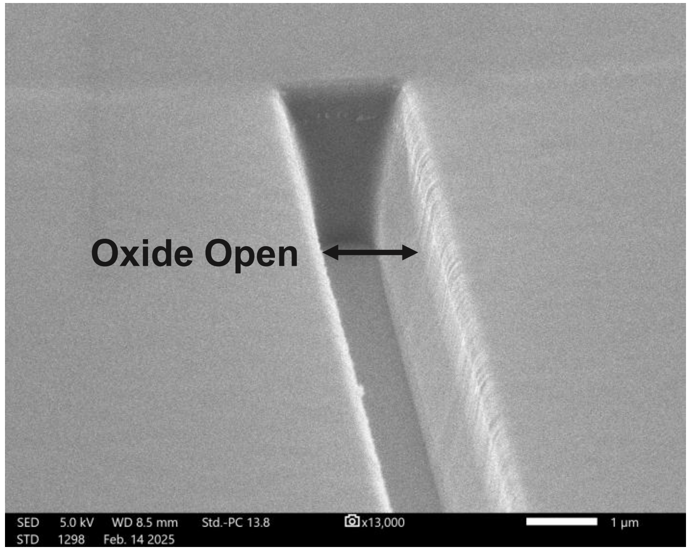

LWLG Polymers vs **Competition/Legacy Polymers**

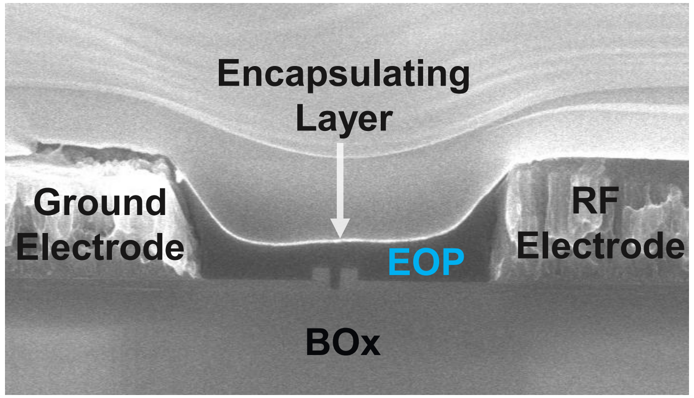


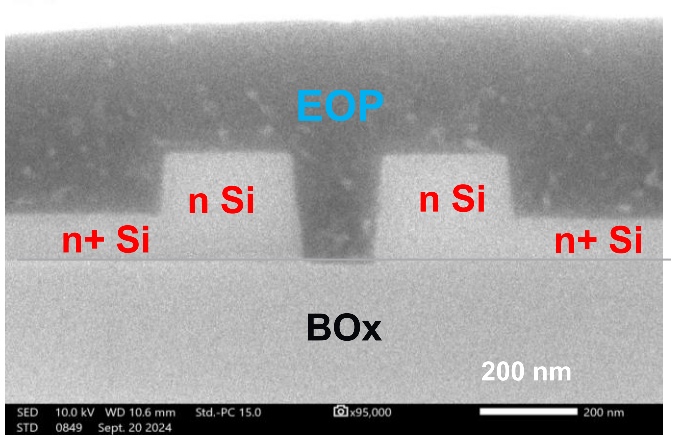
Demonstration in Mass-Producible Foundry Node





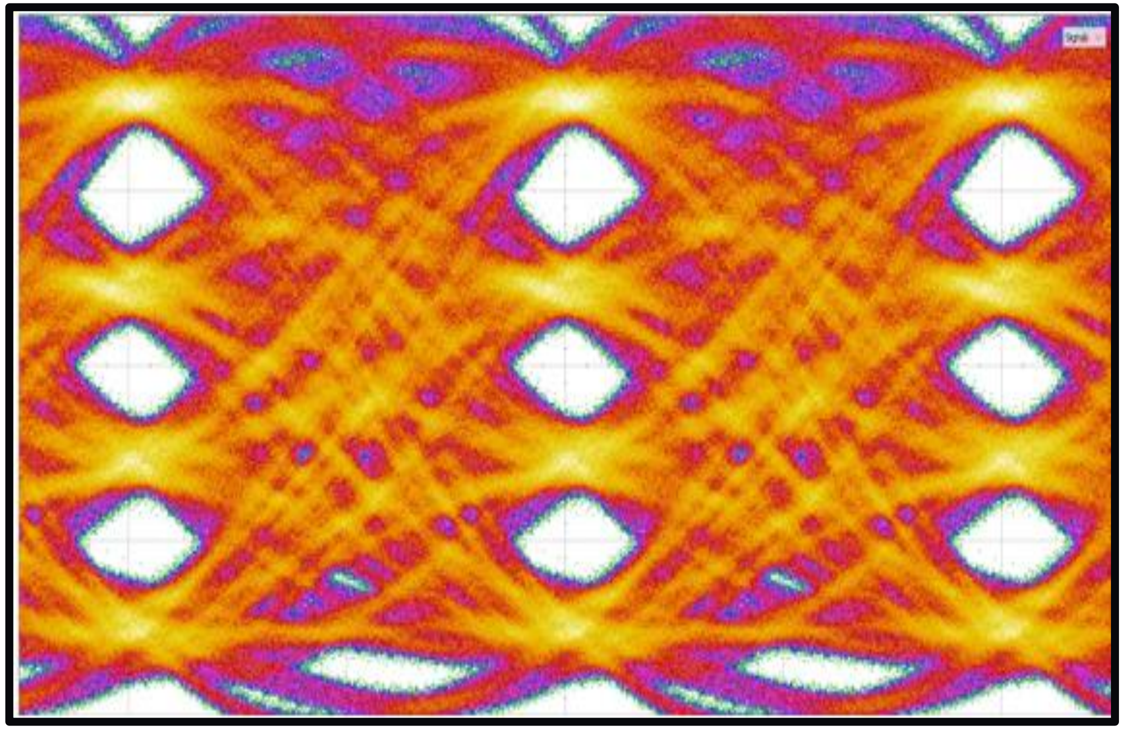




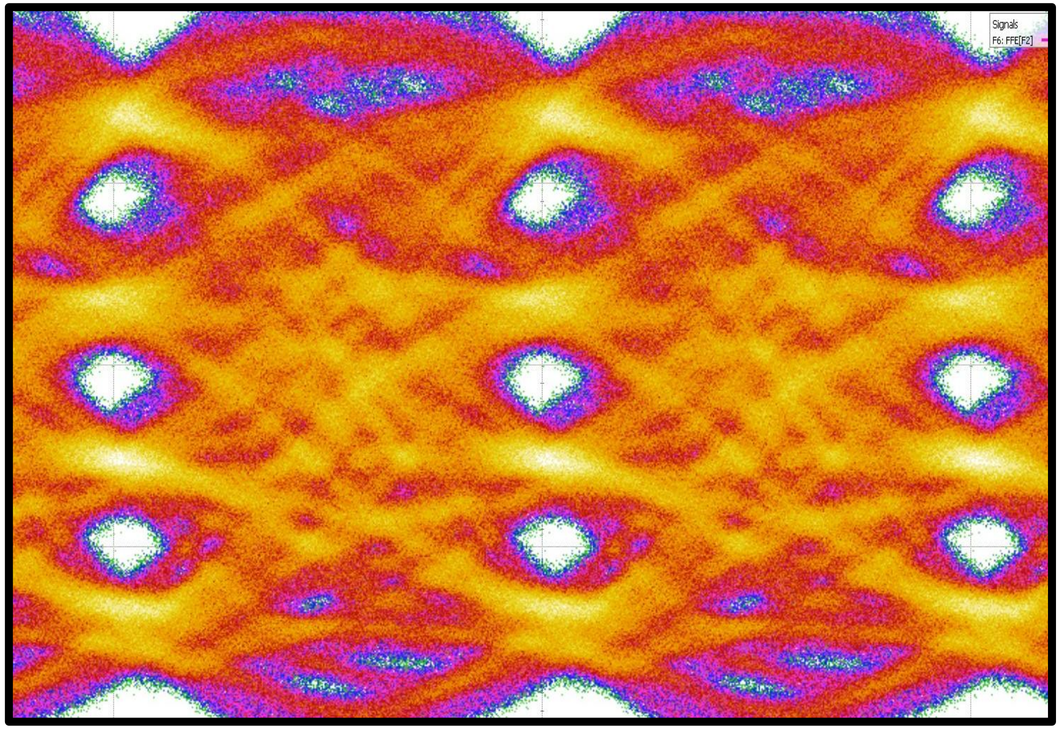


EOP: Electro-Optic Polymer
BOx: Buried Oxide

Eye Diagram: Demonstration Results 1550nm



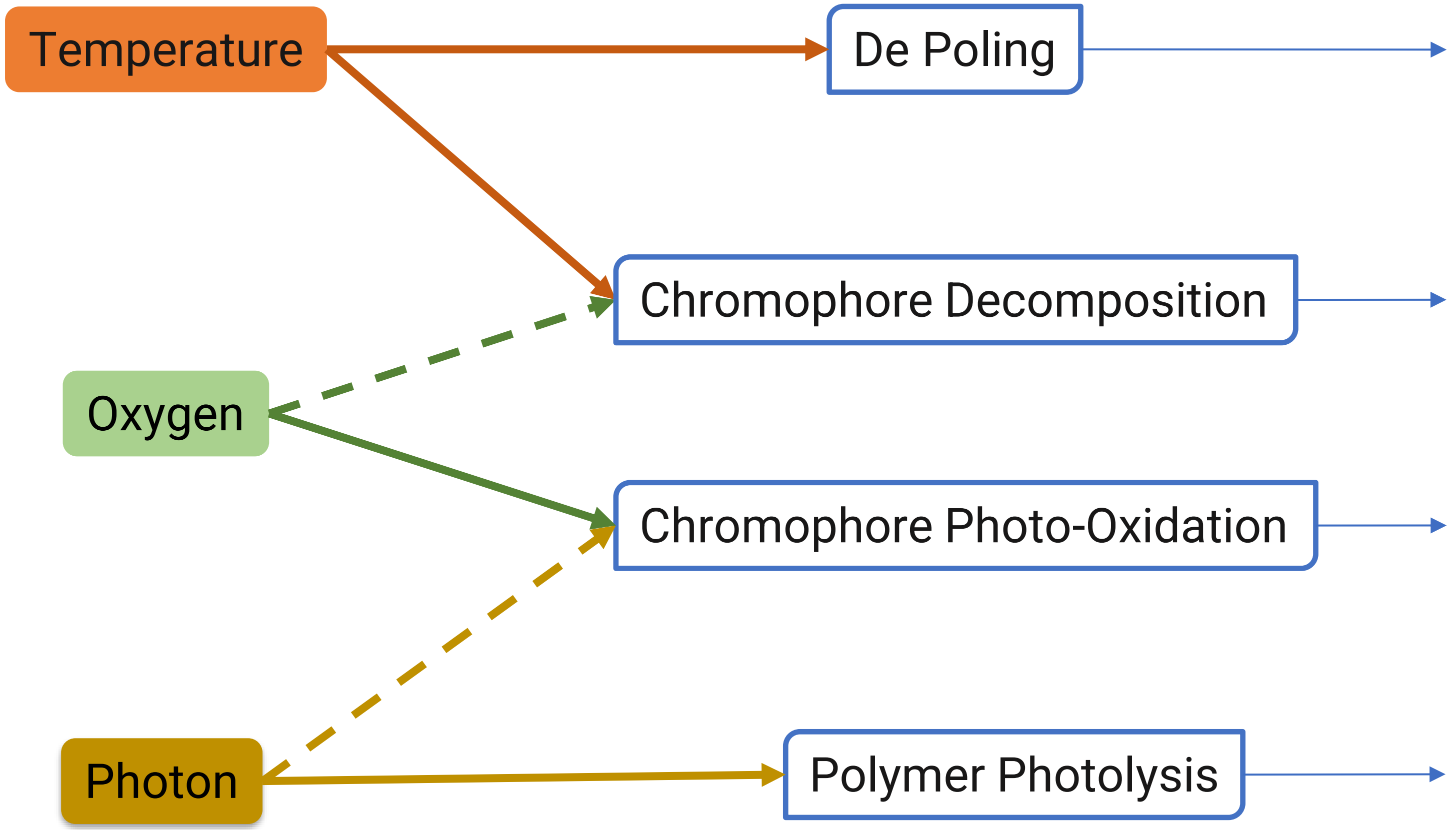
100 Gbaud, 200 Gbit/s, V_{pp} = 0.8 V



120 Gbaud, 240 Gbit/s, V_{pp} = 0.9 V

Clear, Open, PAM4 Eyes at > 200 Gbit/s with Low V_{pp} (<1V)

Understanding Reliability Challenges



Loss of chromophore alignment as temperature approaches T_g

Chromophore decomposition facilitated by O_2 accelerating w/ temp

Chromophore dissociation w/ singlet oxygen produced by 0.97eV photon

Polymer dissociation; caused by 3.81 eV photons

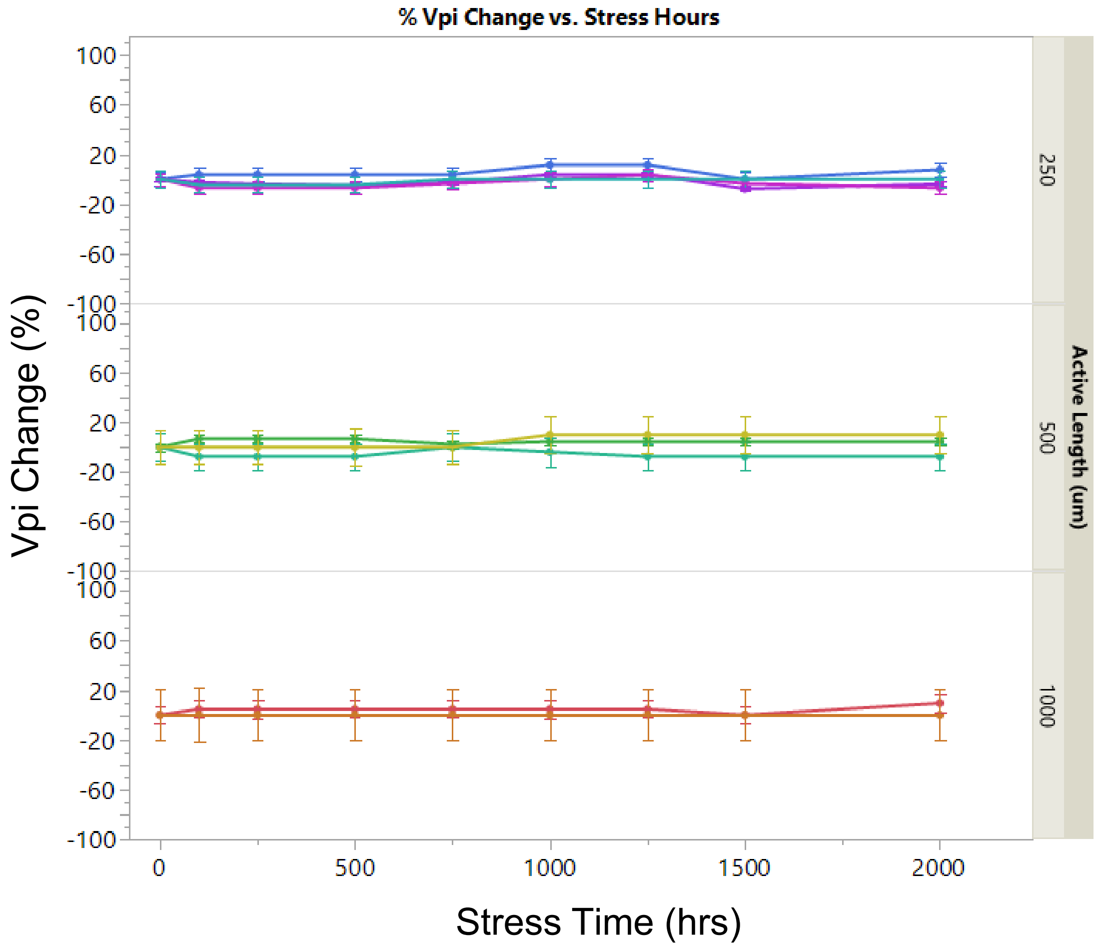
For more details, see our ECOC 2025 Product Focus and IEEE SiPh 2026 Conference Presentations

Temperature and Oxygen are the Primary Stressors in Application

85°C - 85%rh with SOH Devices: Change in V_π

Temperature = 85 °C

Humidity =85%rh



- SOH Device Structure:
  - EO Polymer with ENCAP protection
- Stress Condition:
  - 85C – 85% rh
  - 4 devices- 250um length
  - 3 devices- 500um length
  - 2 devices- 1mm length
- Spec:
  - < 20% variation in V_π for 2,000 hrs
- Result:
  - No measurable V_π degradation for 2,000 hrs

EO Polymer SOH Devices with ENCAP Passing Damp Heat Stress

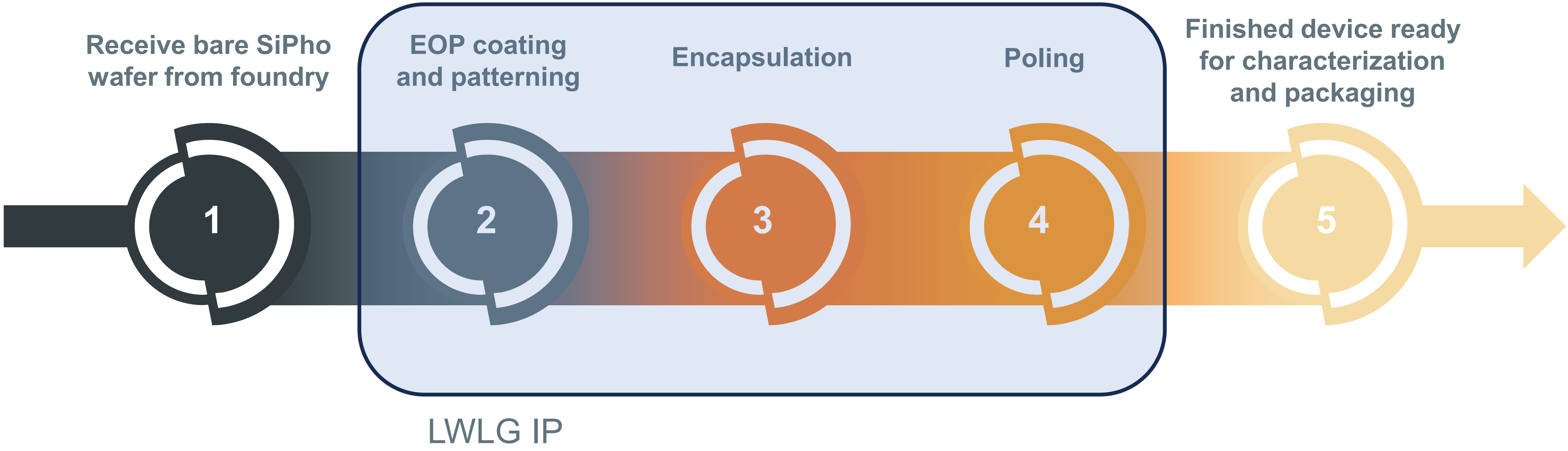
Stress Condition: Slot device. 85%rh-85°C

CMOS Compatible Process Flow

Fully compatible and integrable with SiPho foundry process

LWLG Backend/Encapsulation Process:

Currently performed in-house; fully documented and ready for transfer to foundries



Business Model and Foundry PDKs

Business Model

- EO Polymer Material Sales & IP Licensing/ Royalties for Polymer PDK
- Customers can co-design/ co-optimize using LWLG reference designs

Various Foundries are Implementing LWLG Reference Designs

Publicly announced:

Tower Semiconductor

SILTERRA®

amf ADVANCED MICRO FOUNDRY

gf

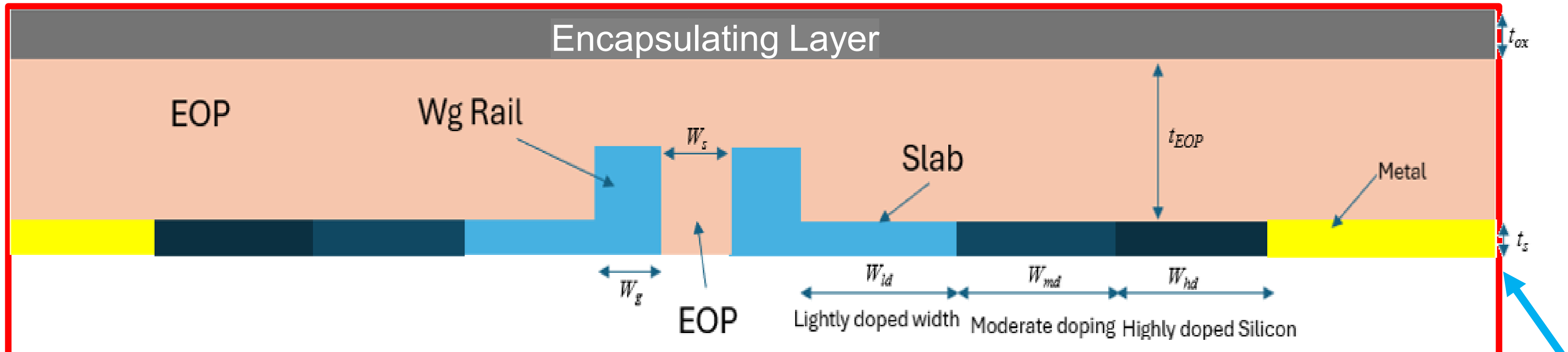
LIGHTWAVELOGIC®
Reference design

LUCEDA PHOTONICS

GDSFACTORY

Lightwave Logic EO Polymer, Processes, and Designs are Ready for 400Gb/s Device Developments

MZI SOH Modulator: PDK Building Blocks



Phase Shifter (unique to SOH)

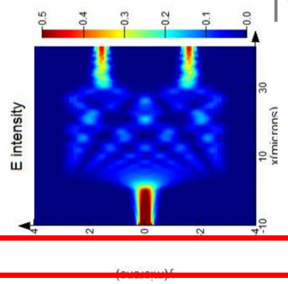
Mode Converter (unique to SOH)

1. Ridge WG to Ridge-Slot WG

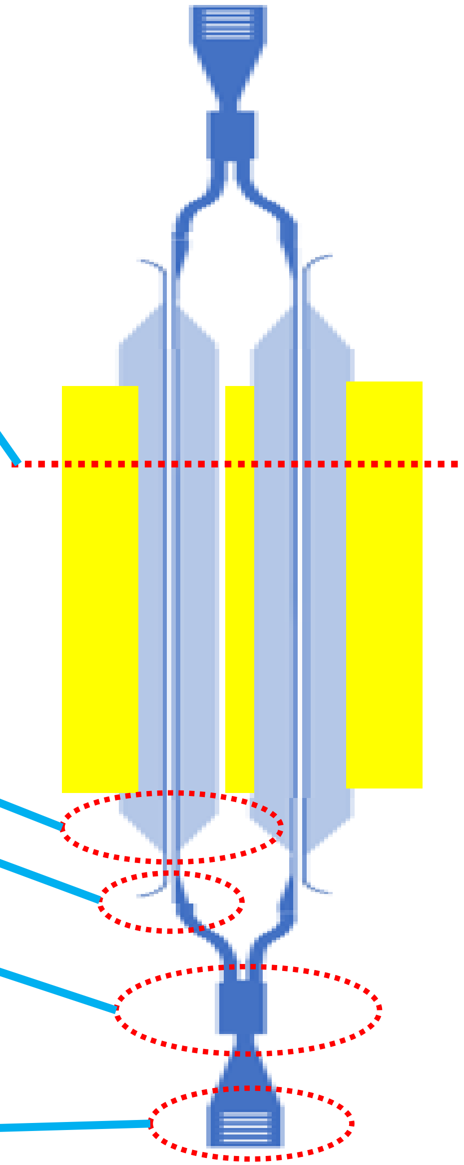
2. Ridge Slot WG to Rib-Slot WG

Power Splitter (common w/ SiPh)

(MMI, Y-Junction, Directional Coupler, etc.)



Grating / Edge Couplers (common w/ SiPh)



Photonic Mode Conversion: Optimization Targets

Optimization targets for the transitions from

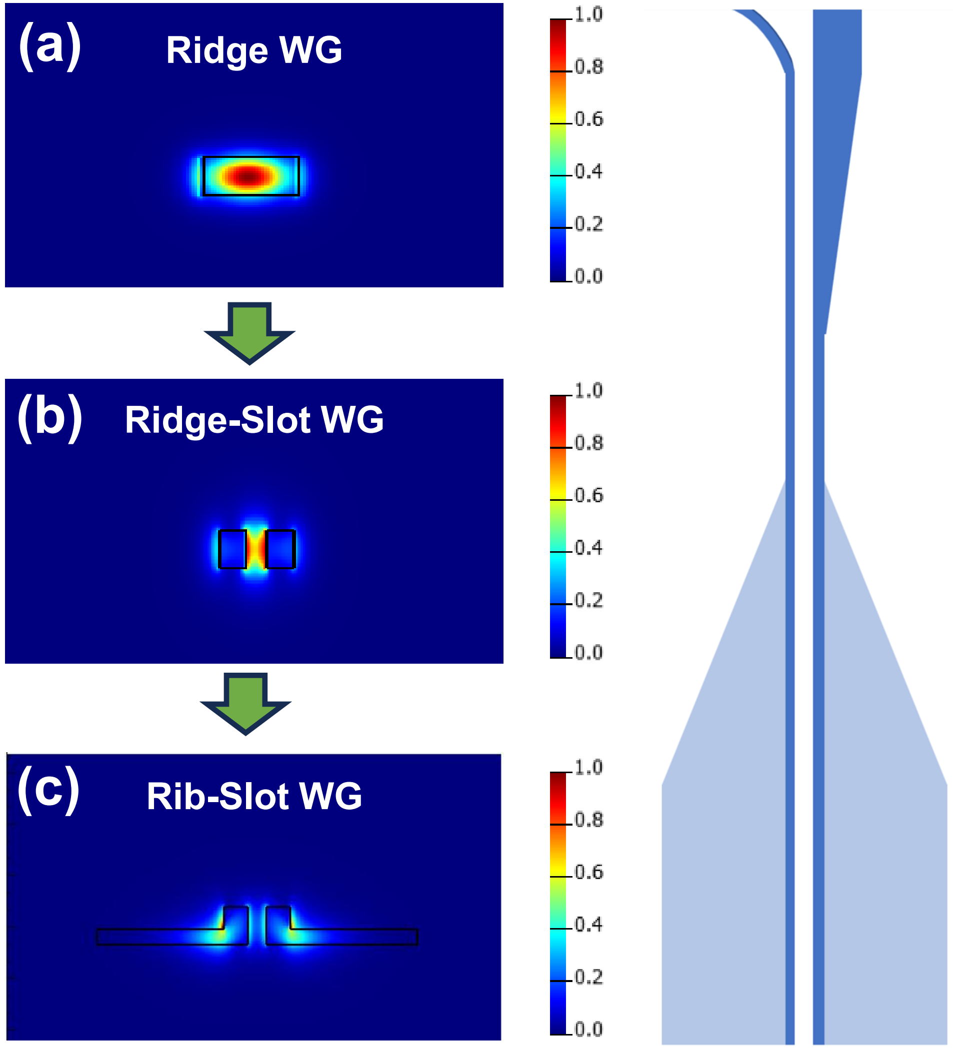
(a) Ridge WG to (b) Ridge-Slot WG to (c) Rib-Slot WG

Maximize the power in the slot

- Higher power in the slot results in lower radiation and scattering from fab non-ideal Si roughness
- Higher EO interaction

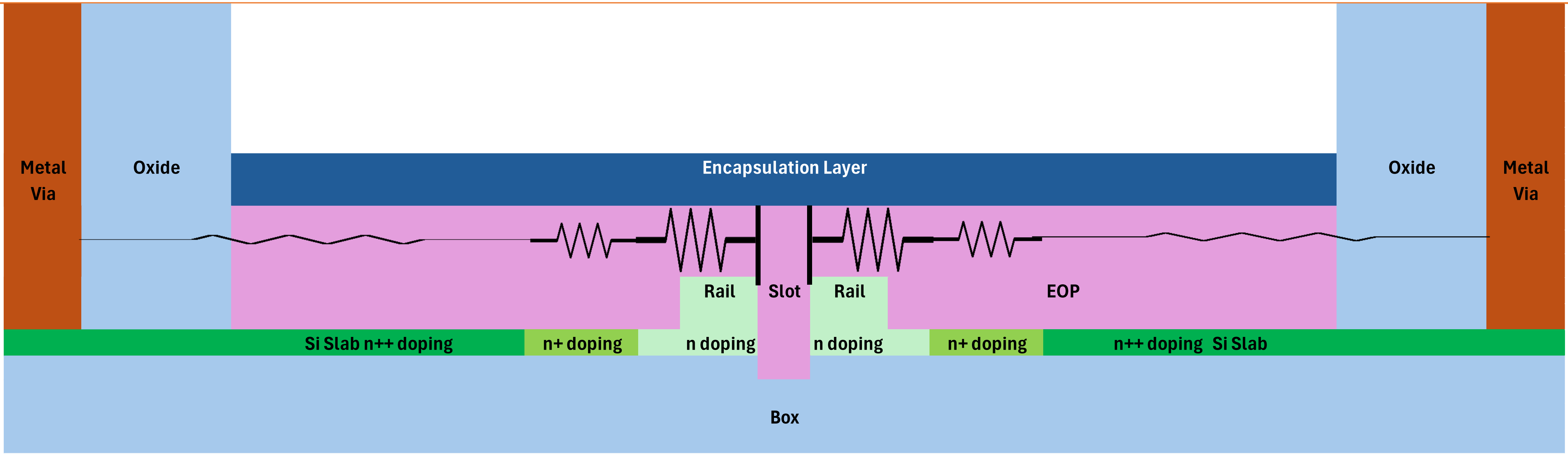
Minimize the insertion loss

- Smooth transitions
- Avoid multi-mode couplings
- Minimizing abrupt changes in the mode evolution



Optimization of Converter Design is Critical to Ensure Adiabatic Mode Transition

Phase Modulation Section Design: Trade-off’s



$$V_\pi L = \frac{1}{2}\frac{\lambda\, Slot\ w}{n_{eop}{}^{3} r_{33eop}\ \Gamma}$$

Confinement ↑ *Thinner Slab*

Confinement ↑ *Narrower Slot*

Optical Loss

Loss ↓ *Lower doping*

$$f\ (BW) = 1/(2\pi\,\mathrm{RC})$$

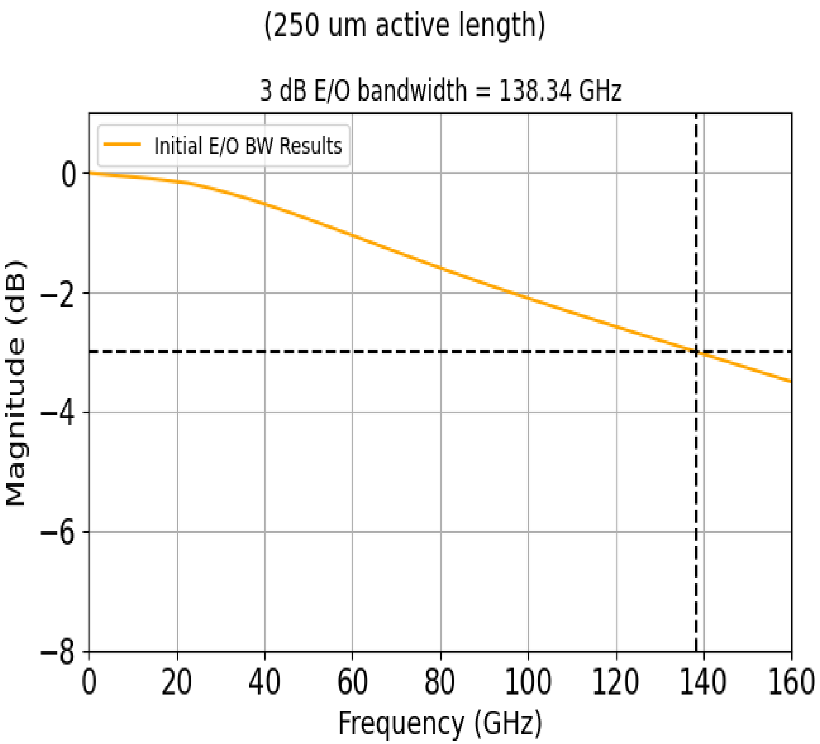
R ↓ *Higher doping*

C ↓ *Wider Slot*

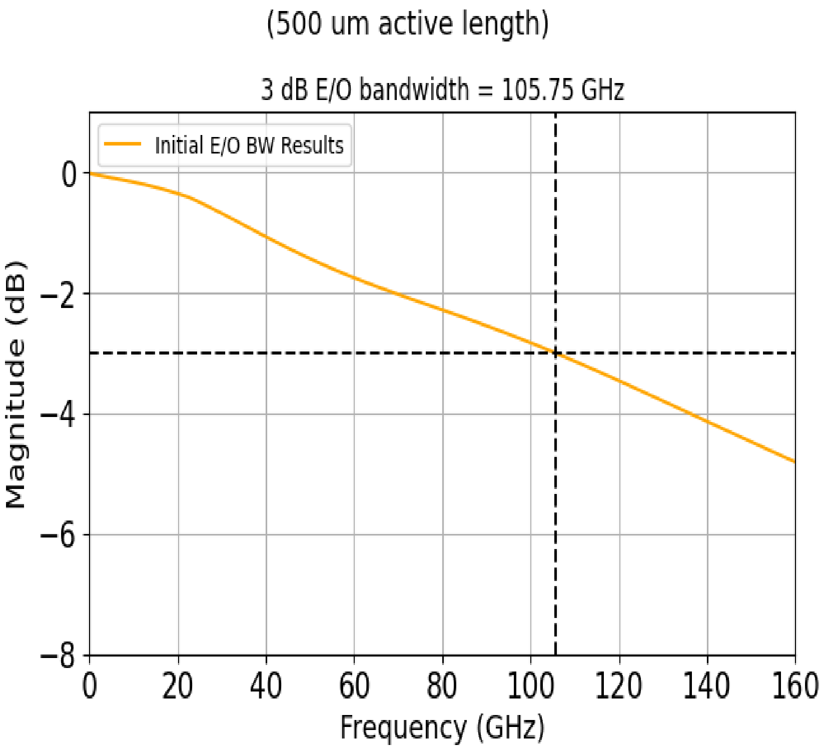
Critical Design Parameters: Slot and Rail Widths, Slab Thickness, and Doping Distribution

RF Performance Optimization: Slots, Slabs and Doping

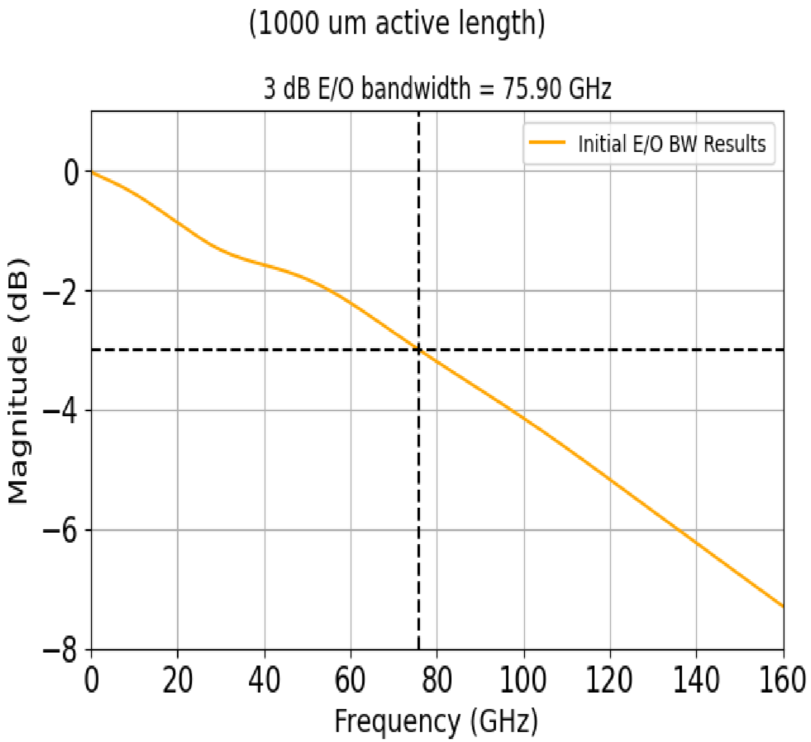
EOBW RF Sims for EO Polymer SOH devices w/ optimized: Slot Widths, Slab Thicknesses, Doping Profile and Concentrations


(250 um active length)

3 dB E/O bandwidth = 138.34 GHz


(500 um active length)

3 dB E/O bandwidth = 105.75 GHz

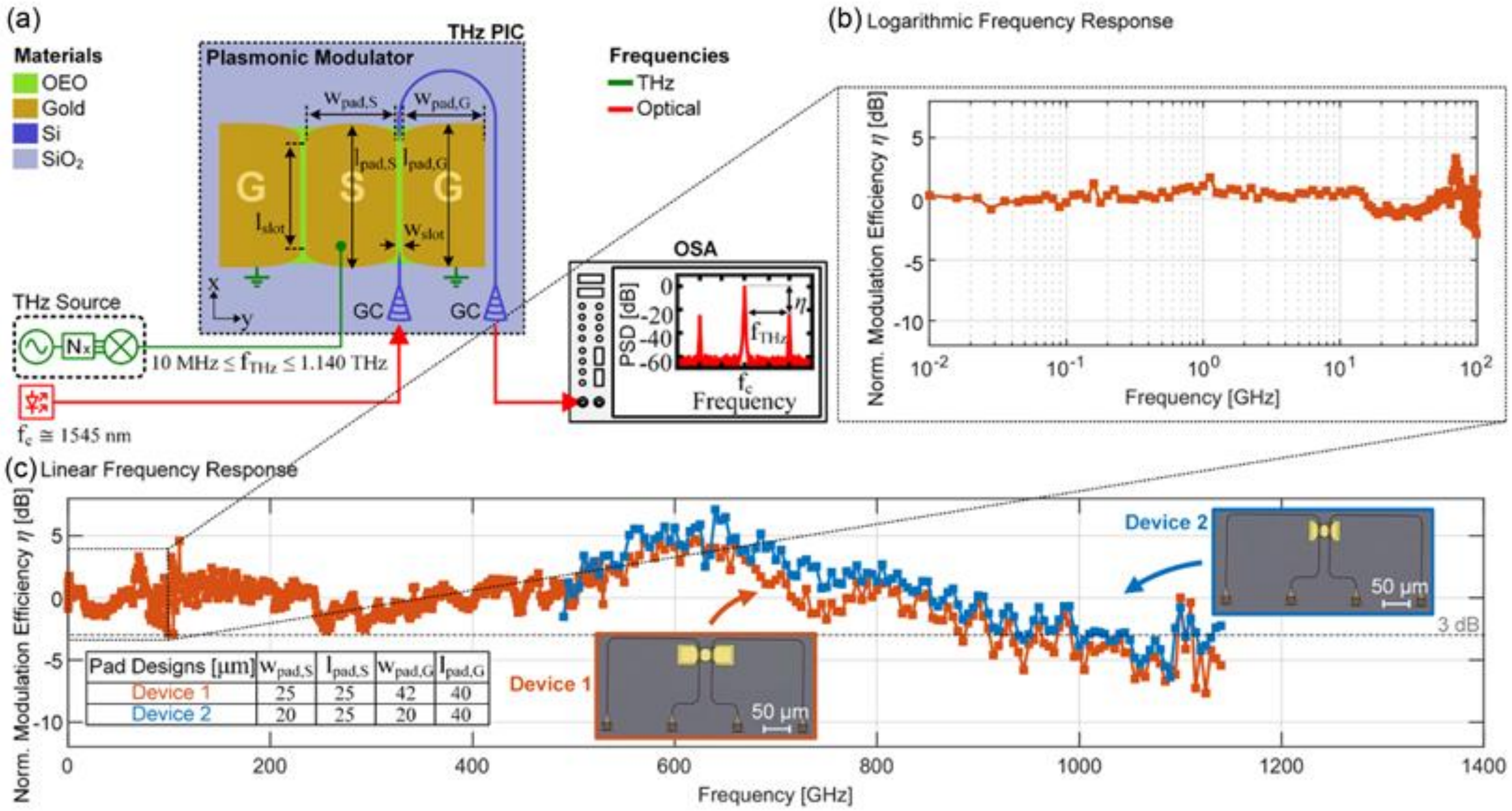

(1000 um active length)

3 dB E/O bandwidth = 75.90 GHz

Certain foundries have optimum geometries and doping profile capabilities available in their PDK today.
Others are running short loops to catch up.

Co-optimization is the Key to SOH Design to Meet Performance Metrics

> 400 Gb/s with EO Polymer based Plasmonic Modulators



Pad Designs [µm]	$w_{pad,S}$	$l_{pad,S}$	$w_{pad,G}$	$l_{pad,G}$
Device 1	25	25	42	40
Device 2	20	25	20	40

Polariton packaged products with Lightwave Logic EO polymer engine

A.H.: Y. Horst et al., Optica, vol12(3):325-8 (2025)

Conclusion

Summary

- LWLG has developed EO polymer, BEOL and SOH modulator device technology
- 200Gb/s designs have shown high bandwidth and low drive voltage
- EO polymer material and encapsulation achieved Telcordia reliability performance at thin film level. Additional reliability studies underway for various reference devices
- 200 and 400Gb/s devices designed and in Fab at multiple foundries with multiple PDKs

Key Takeaway

- Co-optimization with foundries for slots, slabs, rails, doping, and other fabrication specific parameters is underway for 400Gb/s performance in EO polymer-based SOH modulators for both O- and C-band

Lightwave Logic EO Polymer, Processes, and Designs are Ready for 400Gb/s Device Developments

LIGHTWAVELOGIC®

Thank you

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UNLOCKING THE POWER OF SILICON PHOTONICS
WITH EO POLYMERS