Polymer-based hybrid-integrated RF photonics transmitter for mmWave/THz applications

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G.O.T.L.

MARIE CURIE ACTIONS

A European Training Network TERA OPTICS

IMA e.V.

MTT-S IEEE MICROWAVE THEORY & TECHNOLOGY SOCIETY

EuMA European Microwave Association

IEEE

GOTL-UC3M Integrated RF Photonics Generation

RF Photonics Signal Generation

Operating range	Mm-Wave up to THz range
Technique	Optical heterodyne
Applications	Wireless Communication and sensing systems

Photonic integration

On-chip optical signal processing

Ultra-broadband operation

Low transmission loss

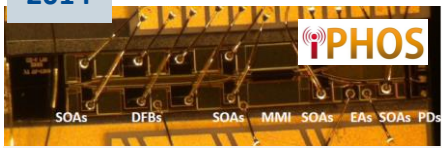
Compactness

Next ?

Generation platforms

InP - Monolithic

2014



G. Carpintero et al, "Microwave Photonic Integrated Circuits for Millimeter-Wave Wireless Communications", Journal of Lightwave Technology, 2014

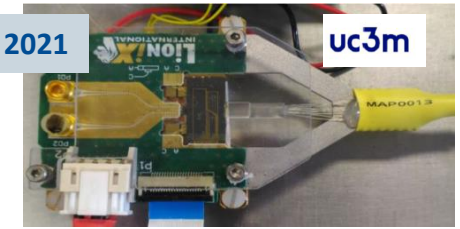
InP/Polymer - Hybrid

2018

G. Carpintero et al, "Wireless Data Transmission at THz Carrier Waves Generated from a Hybrid InP-Polymer Dual Tunable DBR Laser PIC" Nat. Scientific Reports 2018

SiN - Hybrid

2021

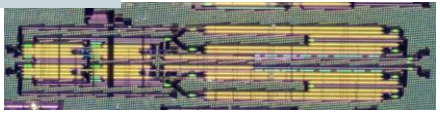


R. Guzmán et al "Widely Tunable RF Signal Generation Using an InP/Si3N4 Hybrid Integrated Dual-Wavelength Optical Heterodyne Source," IEEE JLT, 2021.

Silicon

2021-now

SYNOPSYS® Tower Semiconductor Where Analog and Value Meet



Optical heterodyne source

- Dual filtering
- IQ modulator

GOTL-UC3M Integrated RF Photonics Generation

RF Photonics Signal Generation

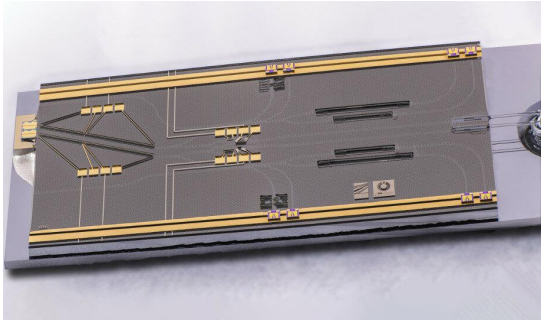
Operating range	Mm-Wave up to THz range
Technique	Optical heterodyne
Applications	Wireless Communication and sensing systems

⇒ Unlock full spectrum from mm-Wave to THz

TERAmeasure
Non-contact millimeter and Terahertz frequency measurement paradigm for instrumentation and sensing applications unlocking metrology-grade results

European Commission

HORIZON 2020

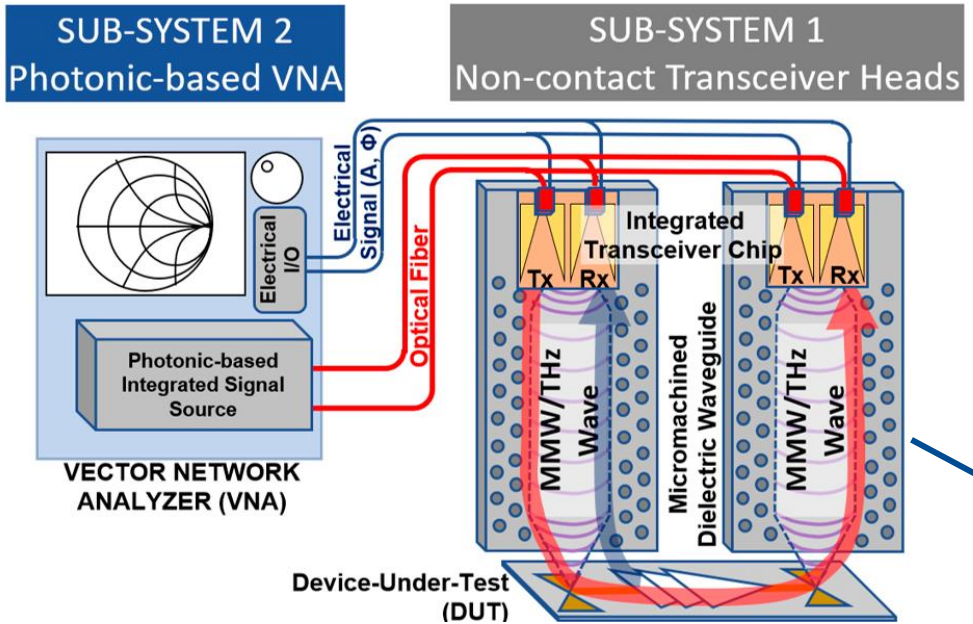


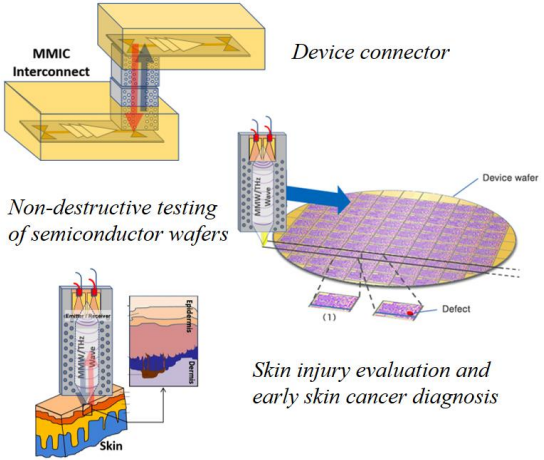
Wideband THz signal generation

on the InP/Polymer integration platform

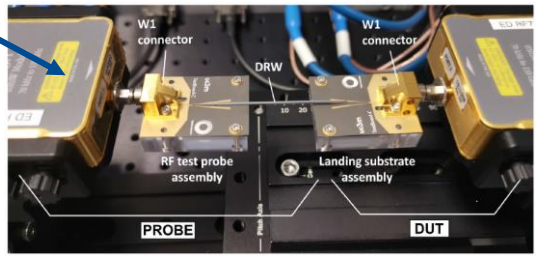
Project objective: Photonic-based VNA signal source

Broadband and contact-free measurement and sensing platform





Dielectric Si waveguides enabled by silicon micromachining



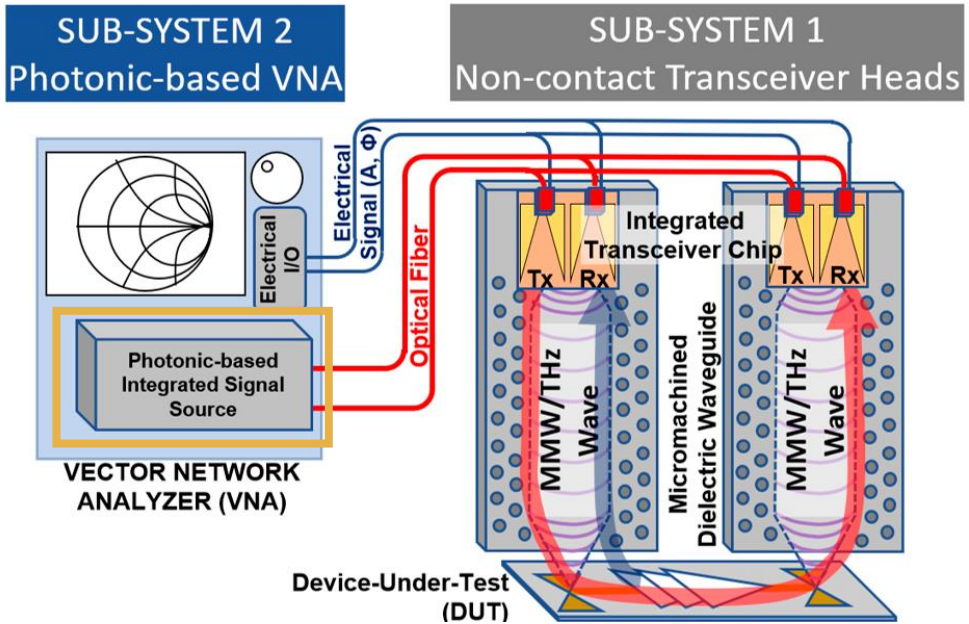
A. Rivera-Lavado, et al., *IEEE Transactions on Terahertz Science and Technology* 13.1 (2022): 34-43.

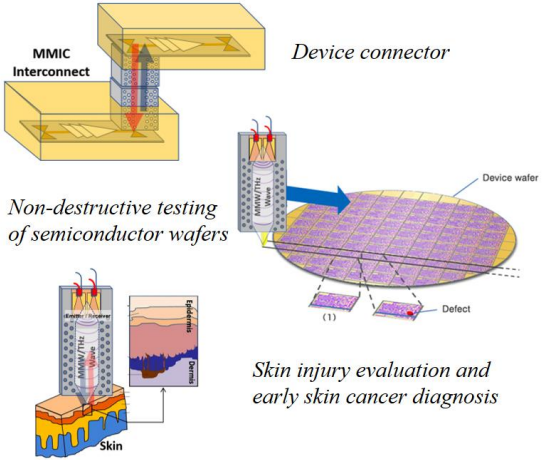
LEAP WAVE

Start-up
Officially constituted

Project objective: Photonic-based VNA signal source

Broadband and contact-free measurement and sensing platform





Requirements

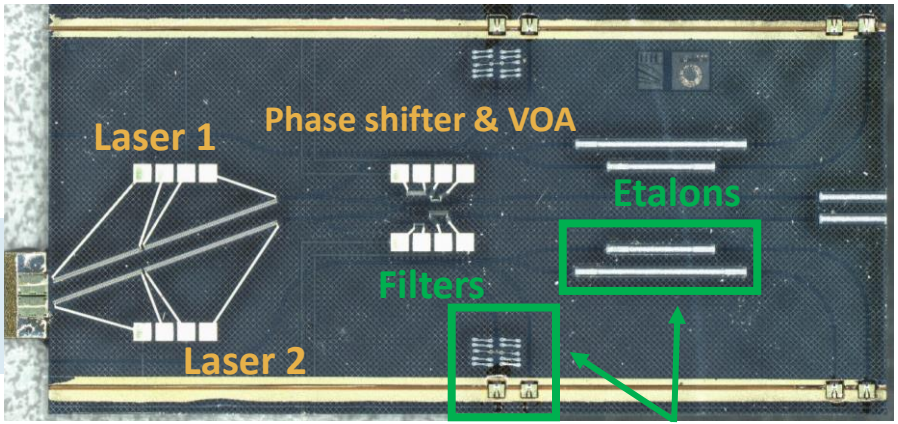
- CW signal generation
- Broadband operation, from 30 GHz to 3 THz
- Phase-sensitive detection
- Compact packaging solution

Hybrid InP/Polymer RF photonics transmitter

THz signal generation and phase sensitive detection

Fraunhofer Heinrich Hertz Institute

Hybrid PICs Group

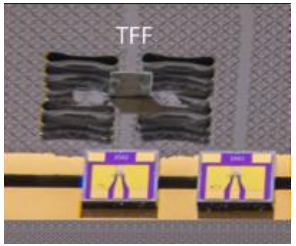


InP Gain chips

Grating & phase sections

On-chip power & wavelength meters

Polyboard



- **Thin-film filters** (TFF) for wavelength determination
- **GRIN lenses** (etalons) for higher resolution monitoring via Vernier effect
- **On-chip photodiodes** (PD) for absolute wavelength and power measurements

Acknowlegements

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TERAOPTICS - A European Training Network

Consortium

15 PhD students

4 universities

2 research institutes

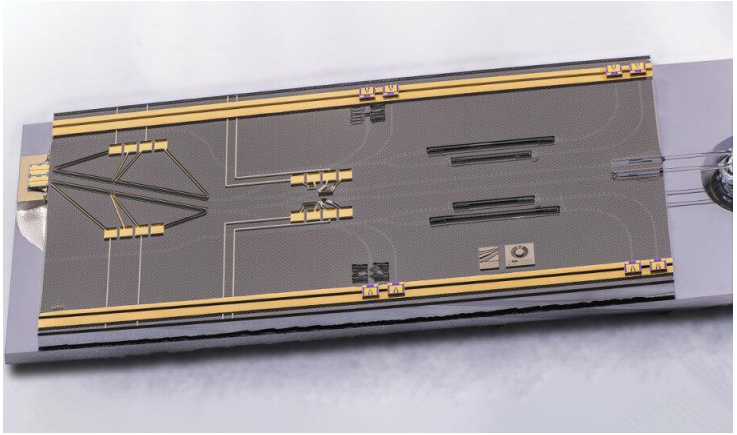
3 SMEs

2 industry

- Applications: Communications, Space, Security, Radio-Astronomy, and Material Science
- THz technology challenges: fundamental aspects and limits, THz generation and detention, photonic integration

Thank you for the attention.

Any questions ?



Wideband THz generation

Phase correction

Packaged solution