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PHOTONICS RESEARCH GROUP

OCTAVE-SPANNING COHERENT SUPERCONTINUUM GENERATION IN A GAP-ON-INSULATOR WAVEGUIDE

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OUTLINE

- What is supercontinuum generation
- SCG in different integrated platforms
- GaP properties and advantages
- Micro-transfer printing for heterogeneous integration
- Waveguide fabrication
- Measurement setup
- Analysis of the spectrum
- Outlook
- Summary

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SUPERCONTINUUM GENERATION

Kuyken et al. NIR DW pump MIR DW

Normal GVD Anomalous GVD Normal GVD

- Dispersion
- Kerr nonlinearity
 - Self-phase modulation
 - Four-wave mixing
- Length of the waveguide

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INTEGRATED PHOTONICS

Silicon SCG Junxiong et al. Si_3N_4 SCG Adrea et al.

SiO₂ SCG Dong et al.

AlGaAs SCG Kuyken et al.

GaP SCG Cheng et al.

Linbo₃ SCG Mengjie et al.

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GALLIUM PHOSPHIDE IS ONE OF THE BEST CANDIDATES

Gallium phosphide

- Wide transparency range
- High refractive index
- Large band gap
- No two-photon absorption at telecom wavelengths
- Strong $\chi^{(2)}$ and $\chi^{(3)}$ nonlinearity

D.J. Wilson et al., Nature photonics 2020

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HETEROGENEOUS INTEGRATION

Wafer-to-wafer bonding

Micro-transfer printing

Full wafer (or die) transfer and bonding + substrate removal

Simultaneous transfer of multiple coupons using elastomer stamp

Source III-V wafer with epitaxial layer stack for lasers

III-V laser processing

Source III-V wafer with processed devices

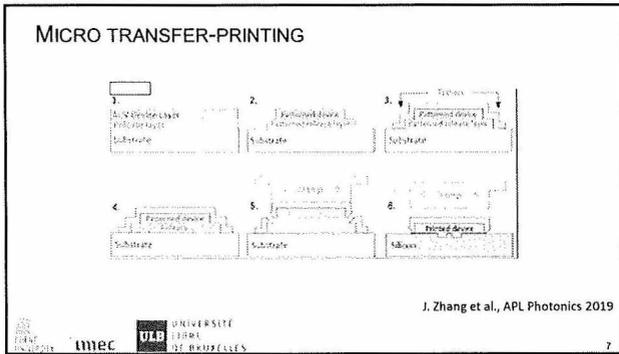
Target Si-PH wafer

Target Si-Fn wafer

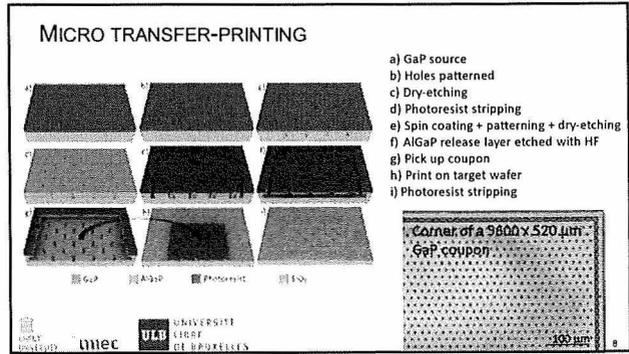
J. Zhang et al., APL Photonics 2019

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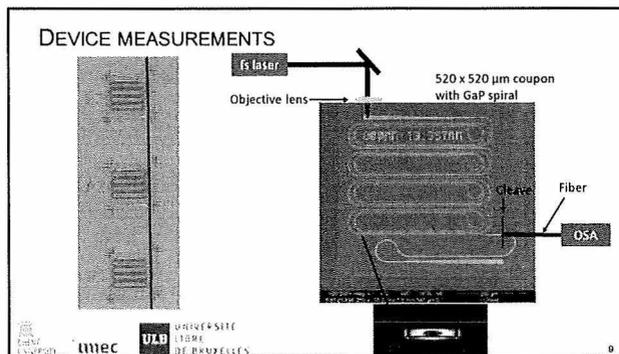
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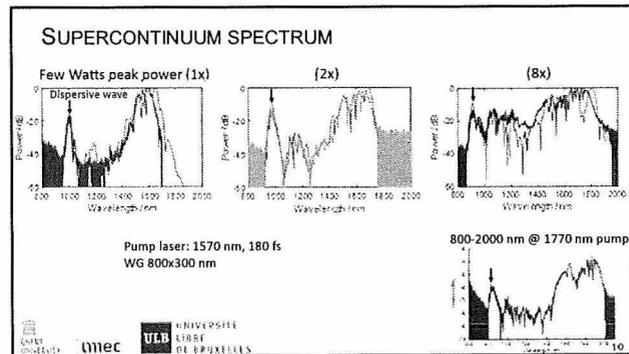
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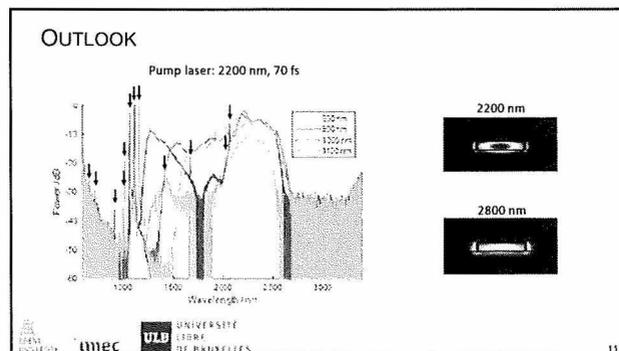
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- ### SUMMARY
- Octave-spanning supercontinuum
 - 900-1800 nm @ 1570 nm pump
 - 800-2000 nm @ 1770 nm pump
 - GaP has no two-photon absorption at datacom and telecom wavelengths
 - GaP high ref index & high nonlinearity = low threshold power & high conversion efficiency
 - Micro-transfer printing facilitates heterogeneous integration
 - Supercontinuum pumped at 2200 nm shows promise

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Presentation

13 March 2024

Octave-spanning coherent supercontinuum generation in a GaP-on-insulator waveguide

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Abstract

We demonstrate supercontinuum generation from 800 to 2000 nm on the highly nonlinear gallium phosphide GaP-on-insulator platform. The supercontinuum is generated in a dispersion engineered waveguide with a length of 13 mm. Femtosecond pulses at the telecom wavelength are broadened in the process. The long length and low loss allow the waveguide to be pumped at the picjoule level.

Conference Presentation

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