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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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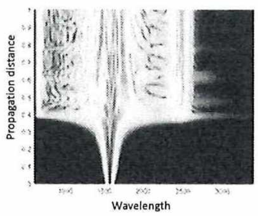
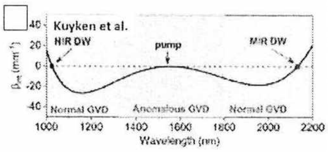
Supercontinuum generation





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

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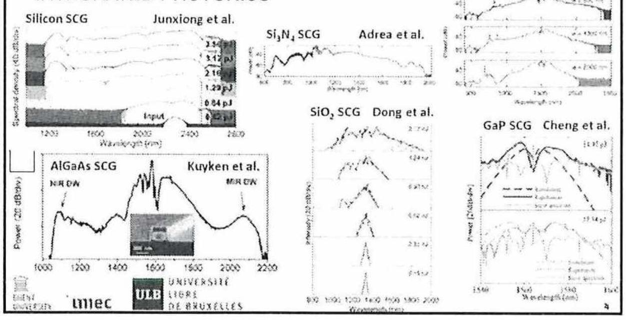
Integrated photonics



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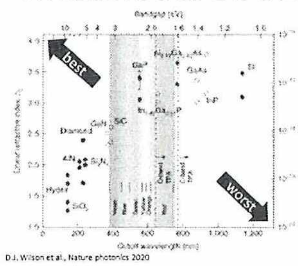
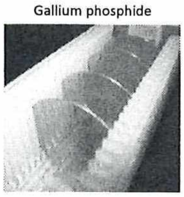
Gallium phosphide is one of the best candidates



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

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

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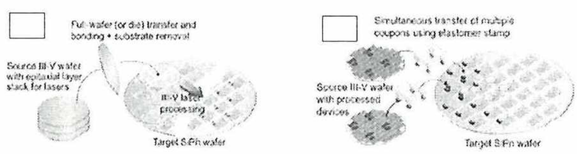
Heterogeneous integration

Wafer-to-wafer bonding

Micro-transfer printing



J. Zhang et al., APL Photonics 2019

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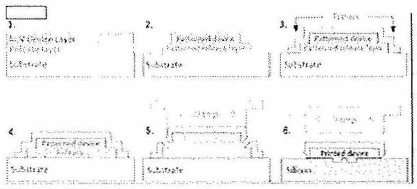
MICRO TRANSFER-PRINTING



J. Zhang et al., APL Photonics 2019

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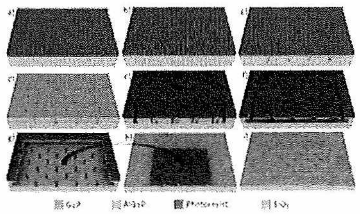
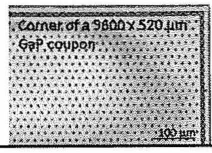
MICRO TRANSFER-PRINTING



a) GaP source
b) Holes patterned
c) Dry-etching
d) Photoresist stripping
e) Spin coating + patterning + dry-etching
f) AlGaP release layer etched with HF
g) Pick up coupon
h) Print on target wafer
i) Photoresist stripping



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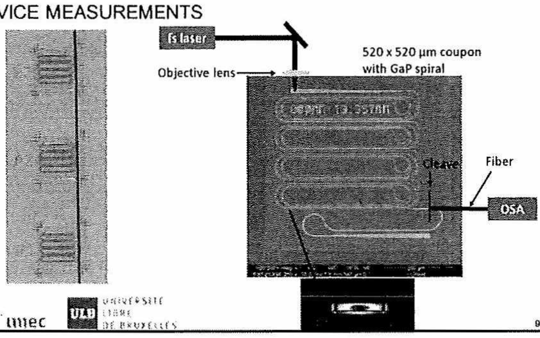
DEVICE MEASUREMENTS



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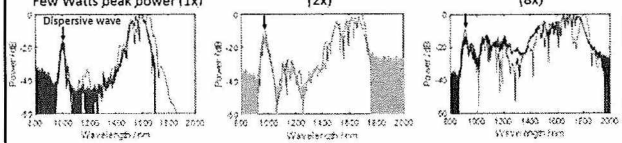
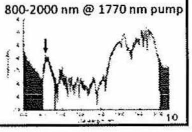
SUPERCONTINUUM SPECTRUM



Pump laser: 1570 nm, 180 fs
WG 800x300 nm

800-2000 nm @ 1770 nm pump



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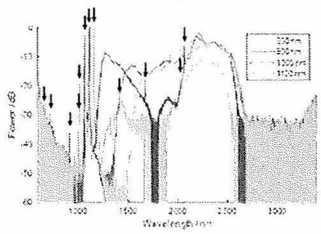
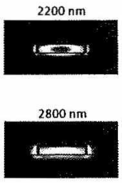
OUTLOOK

Pump laser: 2200 nm, 70 fs





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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 picojoule level.

Conference Presentation