Supercontinuum Generation in Orientation-Patterned Gallium Phosphide

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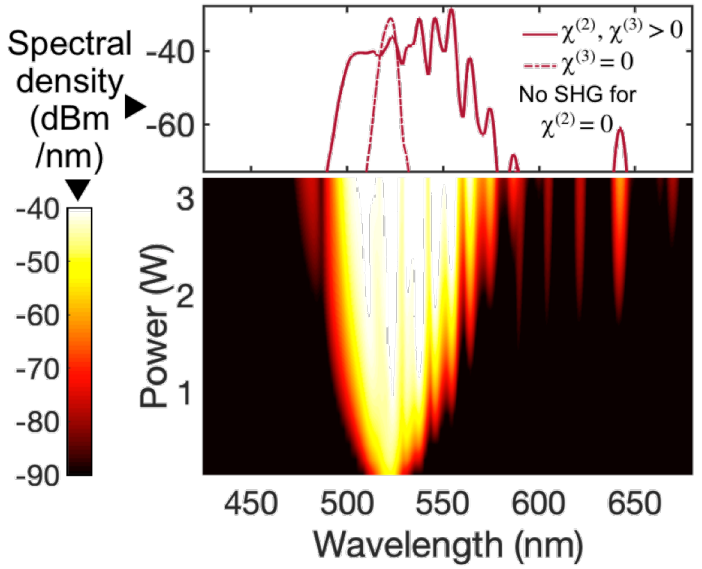
A visible supercontinuum is produced in bulk orientation-patterned gallium phosphide from 100-MHz, 1040-nm femtosecond pulses. High-order parametric gain near 550 nm, seeded by self-phase-modulated spectral sidebands, underpins this new and simple supercontinuum process.



Project Description

- Supercontinuum generation from nJ femtosecond lasers is common in photonic-crystal fibres, channel waveguides, and microresonators, in which confinement optimizes both dispersion and nonlinearity.
- In *bulk media*, supercontinuum generation was not previously observed at such energies, but here we introduce a new process using $\chi^{(2)}$ and $\chi^{(3)}$ effects to produce broadband visible light in bulk orientation-patterned gallium phosphide (OPGaP) from nJ pulses.
- Experiment and theory are combined to show that high-order parametric gain pumped by the second-harmonic light of the laser and seeded by frequency-doubled self-phase-modulated sidebands is responsible for the visible supercontinuum observed.

Key Results

- First example of supercontinuum generation in a bulk nonlinear crystal pumped by a high-repetition-rate femtosecond laser oscillator.
- A nonlinear-envelope-equation model (results above) shows that both $\chi^{(2)}$ and $\chi^{(3)}$ effects participate in this supercontinuum process.
- Self-defocusing from cascaded $\chi^{(2)}$ effects limits spectral broadening.
- QPM engineering could enhance the process to yield useful powers.

Cover article: Rutkauskas *et al.*, Optica **7**, 172 (2020).
Featured on BBC Radio Scotland, 7 March 2020.
Highlighted in *What's Next in Ultrafast Optics: Hot Topics at CLEO*.
To be featured in *Photonic Spectra* magazine, July 2020.