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Highly efficient Raman-shifting optical architecture

A novel optical architecture for frequency-downshifting laser light to efficiently generate high-power, narrow-bandwidth light between 1100–1500 nm, ideally suited for nonlinear frequency conversion to, for example, 550–750 nm.

Proposed use

The technology can shift the output of near-infrared lasers to longer wavelengths with extremely high efficiency and tailorable spectral properties. It can generate high-power, narrow-bandwidth light at arbitrary wavelengths in the 1100–1500 nm region with a wide range of pulse durations (ps to CW) and pulse energies up to the microjoule-level. These unique laser parameters can be used for applications such as spectroscopy, silicon processing, communications and medical.

The parameters of the light generated are particularly well suited to subsequent nonlinear frequency conversion, for example, second-harmonic generation to the 550–750 nm region with high efficiency. This enables the realisation of multi-watt average power pulsed visible laser sources ideally suited for applications such as super-resolution microscopy, flow cytometry and photoacoustic imaging.

Problem addressed

Currently, there are no laser gain media that emit in the 1100–1500 nm wavelength region that can generate 100's W average power, microjoule-level pulses at megahertz repetition rates. Our technology can achieve these parameters with a narrow spectral bandwidth, enabling the development of unique laser sources.

Technology overview

The technology is based on a novel configuration of introducing seed light between multiple frequency-downshifting stages. The frequency-downshifting utilises the nonlinear process of Stimulated Raman Scattering. The technology has been demonstrated using optical fibres to benefit from a robust, alignment-free integrated device but the technology is compatible with any Raman-active media. The technology is designed for OEM integration but can equally be retrofitted to existing laser solutions.

Benefits

- Generate narrow-bandwidth light with high average power at any wavelength between 1100–1500 nm
- Compatible with a wide range of pulse durations (ps to CW) at arbitrary repetition rates
- Microjoule-level pulse energy can be achieved at megahertz pulse repetition rates
- Ideal for SHG to 550–750 nm for life science applications e.g. microscopy, flow cytometry and photoacoustic imaging
- Demonstrated using optical fibres for robust, alignment-free device but compatible with any Raman-active media
- Designed for OEM integration

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