Optical Engineering

OpticalEngineering.SPIEDigitalLibrary.org

Nonlinear Frequency Conversion

Rita D. Peterson
Christelle Kieleck
Peter G. Schunemann

SPIE.

Rita D. Peterson, Christelle Kieleck, Peter G. Schunemann, "Nonlinear Frequency Conversion," *Opt. Eng.* **57**(11), 111801 (2018), doi: 10.1117/1.OE.57.11.111801.

Nonlinear Frequency Conversion

Rita D. Peterson
Air Force Research Laboratory
Wright-Patterson Air Force Base, Ohio, United States

Christelle Kieleck
Fraunhofer IOSB
Ettlingen, Germany

Peter G. Schunemann
BAE Systems
Nashua, New Hampshire, United States

The papers that constitute the *Optical Engineering* Special Section on Nonlinear Frequency Conversion reveal a multi-faceted, constantly evolving field. Nonlinear optical phenomena appear in an array of applications, including optical signal processing, spectroscopy, and the generation of designer wavelengths. As evidenced by the papers published here, advances in the field continue to rely on research in such areas as the fundamental study of nonlinear effects, theoretical development and modeling, materials development, and device concepts.

Record output power levels and extremely broad spectral coverage are achieved using a femtosecond Yb fiber laser to synchronously pump an optical parametric oscillator based on the exotic nonlinear crystal mercury thiogallate, $HgGa_2S_4$.

Next, a novel phase-matching scheme for third harmonic generation is proposed based on the use of engineered dispersion in multilayered metamaterials to compensate for natural material dispersion.

Broadband supercontinuum generation is demonstrated by pumping a single-mode ZBLAN fiber with a femtosecond erbium-doped fiber laser that is mode locked through the use of a carbon-nanotube-based saturable absorber.

The dispersion properties of a single crystal sapphire fiber with a unique windmill microstructure are analyzed, and single-mode operation over a broad spectral range enables the generation of infrared supercontinuum characterized by dense frequency combs.

As a growing number of laser applications demand spectral output deeper and deeper into the mid-infrared at ever-increasing power levels, the power-handling limits of chalcogenide fibers will be of vital importance. The final paper in this special section examines the optical nonlinearities and thermal effects that will ultimately limit the power transmission in various operating regimes, predicting delivery of >100 W if sufficiently low losses and efficient cooling can be achieved.