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Jonathan W. Evans
Patrick A. Berry
Brian D. Dolasinski

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Jonathan W. Evans
Air Force Research Laboratory
Sensors Directorate
Wright-Patterson AFB, Ohio 45433
E-mail: jonathan.evans.6@us.af.mil

Patrick A. Berry
Air Force Research Laboratory
Sensors Directorate
Wright-Patterson AFB, Ohio 45433
E-mail: patrick.berry@us.af.mil

Brian D. Dolasinski
ARA — BerrieHill Research Division
Fairborn, Ohio 45324
E-mail: brian.dolasinski.ctr@us.af.mil

The continuing development of compact and efficient solid-state sources of coherent radiation in the near-infrared band of the electromagnetic spectrum is of vital importance for defense applications and to applications across several industries that rely on advanced laser-based materials processing and welding techniques. Solid-state lasers are especially well suited to such applications because of the harsh environments they must operate in; both on the battle field, and in the assembly-line. In this special section, we highlight work that spans the full range of laser research from fundamental materials characterization to full subsystem development.

We include several papers first presented at the LASE conference as a part of SPIE's Photonics West 2017. We have invited each author to expand their contribution and to submit their work to peer review. These six papers have been the result of that review process and are included here because the editors feel they add significant value to the current knowledge base in the field of solid-state lasers.

Three of the included papers showcase sources in the eyesafe laser band near 1.5 μm. The work of Baranova et al. details the demonstration of a compact, pulsed, eyesafe laser illuminator operating with >10 mJ pulse energies at repetition rates as high as 160 Hz. The design uses an end-pumped solid-state laser geometry to produce adequate beam quality within a compact volume of <3760 cm^3 and offers additional potential for power scaling based on compensation of birefringence.

Elsen et al. describe the development of a 1.6 μm OPO/OPA source for atmospheric lidar applications such as remote measurements of aerosol concentrations, wind speed, and temperature. An OPO/OPA frequency conversion setup was designed and built to address the 1.6 μm band required to measure the concentrations CH_4 and CO_2. With potassium titanyl phosphate (KTP) as the nonlinear medium, the OPO/OPA delivered more than 100 mJ of output energy at 1645 nm from 450 mJ of pump energy with a pulse duration of ~23 ns. This corresponds to a quantum conversion efficiency of about 22%. In addition to demonstrating optical performance for future lidar systems, this laser will be used to qualify optical components for the French–German climate satellite methane remote-sensing lidar mission (MERLIN).

Zhao et al. report on a high-power continuously tunable Tm:$CaGdAlO_4$ (Tm:CALGO) laser with a volume Bragg grating (VBG) as a wavelength selector using a ~1.7-μm Raman fiber laser as a pump source. The researchers leverage the high diffraction efficiency of the VBG, the low quantum loss of in-band pumping, and the smooth and flat gain spectrum of Tm:CALGO to produce >5 W of output in the range of 1945.6 to 1993.7 nm with a total tuning range from 1919.7 to 1993.7 nm. The beam quality M^2 factors at 5 W output power around 1959.5 nm were 1.31 and 1.32 in the x- and y-directions, respectively.

Several papers included in this special section pursue further investigation of the familiar Yb^{3+} laser system. Gebremichael et al. detail the full characterization of the anisotropy of the absorption properties of Yb-doped $Li_6Gd_{0.75}Yb_{0.25}(BO_3)_3$ and $Li_6Y_{0.75}Yb_{0.25}(BO_3)_3$ crystals grown by the Czochralski method. They focus on the study of their absorption at the zero line transition as a function of the polarization direction of the incident light for two different crystal cuts of each compound. They identify the optimum crystal orientation(s) for laser gain media made from such crystals.

Kim et al. present an investigation into the characteristics of a mode-locked Yb-doped fiber laser using a birefringent plate as a spectral filter. The total dispersion value of the laser cavity was 0.04673 ps^2 at a center wavelength of 1.03 μm, such that the mode locking was achieved in the normal-dispersion region. The repetition rate of the mode-locked laser was ~104.2 MHz and the FWHM of the optical spectrum was ~18.09 nm. The pulse was compressed to ~148 fs using a pair of external diffraction gratings. The center wavelength of the optical spectrum could be varied from 1026.9 to 1045.6 nm by rotating the optical axis of the birefringent plate.

Finally, the study by Baselt et al. describes a method to increase the spectral power density of super-continuum sources based on mode-locked Yb^{3+} fiber lasers by amplification of the pulses in a nonlinear photonic crystal fiber (PCF). An ytterbium-doped PCF was manufactured by a nanopowder process and used in a fiber amplifier setup as the nonlinear fiber medium. The source exhibited an order-of-magnitude increase in the SPD from 1100 to 1350 nm. Such a source promises to improve the speed and resolution of optical coherence tomography.

Jonathan W. Evans is a research physicist with the U.S. Air Force Research Laboratory's Sensors Directorate at Wright-Patterson Air Force Base, Ohio. He received the BS degree in electrical engineering from Cedarville University in 2008. He received the MS degree in electro-optics from the University of Dayton in 2010 and the PhD degree in optical sciences and engineering from the Air Force Institute of Technology in 2014. His research interests include transition metal lasers, nonlinear parametric conversion, and spectroscopy of novel laser systems.

Patrick A. Berry is a senior research engineer in the U.S. Air Force Research Laboratory's Sensors Directorate at Wright-Patterson Air Force Base, Ohio. He received the BS degree in chemistry and physics from the University of Wisconsin - La Crosse in 2003 and the MS and PhD degrees in electro-optics from the University of Dayton in 2005 and 2010. His primary areas of interest are in solid-state laser development and spectroscopy of laser materials.

Brian D. Dolasinski is a senior electrical engineer II at Applied Research Associates - Berriehill Research Division. He received a BS degree in physics from Indiana University-Bloomington in 2006, an MS in nuclear physics from Ball State University 2010, and a PhD degree in electro-optics from the University of Dayton in 2014. His primary areas of interest are in solid-state lasers and the development of bidirectional reflectance function (BRDF)-related instrumentation.