Introduction to the Issue on Fiber Lasers

WELCOME to the IEEE JOURNAL OF SELECTED TOPICS IN QUANTUM ELECTRONICS (JSTQE) Issue on Fiber Lasers. Fiber lasers is an advanced field of modern science entering in all branches of science. This field continues to vastly expand with state-of-the-art developments across the entire spectrum of scientific, military, medical, industrial, and commercial applications ranging from spectroscopy to material cutting, welding, and marking.

The field of lasers has a relatively short history starting from 1960 with Maiman's first demonstration of laser action in ruby followed by first fiber laser demonstration by Snitzer in 1961. The recent explosive development and applications of the physics and technology of fiber lasers greatly stimulate new advanced research areas including generation of ultrashort and high-energy pulses. Researchers in the area of material science are continuously trying to develop new composition-based doping host for improving the lasing efficiency with low photodarkening phenomena which is vital for high-power laser. At the same time, researchers are also striving to develop new kind of fiber laser sources at near-infrared region (NIR) beyond 2.0 μm, which is very much useful for biomedical applications. At present, optical fiber materials with ultrabroadband gain in the NIR, 1100–1500 nm, are of great interest for the development of compact, versatile, and high brightness light sources in the low-loss transmission window of silica fiber, where no efficient active fiber exists. Applications for such a source are diverse, including communications in the 1300–1500-nm region, OCT for imaging, generation of efficient yellow light by frequency doubling for dermatological, and laser guide star use. Existing sources in this wavelength range have either limited bandwidth or limited efficiency. In particular, rare earth (RE) doped glasses are generally limited to 100-nm bandwidth in the NIR, and the available RE transitions do not span 1150–1500 nm with high efficiency. To solve this problem, a new kind of bismuth doped fiber laser is recently developed. On the other hand, laser researchers are continuously working to generate shorter laser pulses, which have become increasingly important in a wide range of scientific, technological, medical, and other applications. The main problems associated with the generation of shorter pulses are a relatively high dispersion and nonlinearity of fiber resonator, where the effects of dispersion can be compensated by different approaches. The nonlinearity plays a critical role in the design of advanced fiber laser systems through substantial efforts made to reduce the resonator nonlinearity by using large-mode-area fibers. This direction presents an important modern trend in laser technology. On the other hand, understanding and mastering nonlinear physical fiber systems offer the potential to enable a new generation of laser concepts. Therefore, it is of great importance to study physics and engineering design of laser systems based on nonlinear photonic technologies. In particular, new nonlinear approaches and solutions shall pave the way for the development of advanced mode-locked fiber lasers with ultrashort high-energy pulses.

The objective of this JSTQE Issue on Fiber Lasers is to highlight recent progress and trends in fiber laser technology. The papers published in this issue cover a broad range of advanced fiber laser areas summarized in the following sections:

1) Fiber lasers.
2) Mode-locked lasers.
3) Optical amplifier science.
4) Optical amplifier technology.
5) Optical waveguide.
6) Fiber based sensors.
7) Optical signal processing and frequency conversion technology.
8) Industrial applications.

These key research topics are highlighted as comprehensive overviews of the current status and future trends as well as original results and recent developments in the field of fiber lasers. This issue contains 74 papers, including 19 invited and 55 contributed papers authored by well-established research groups and promising scientists from all over the world. The invited papers include performance scaling of ultrafast laser systems by coherent addition of femtosecond pulses, applications of fiber lasers for the development of compact photonic devices, carbon-nanotube-based nonlinear fiber devices for fiber lasers, bidoped optical fibers and fiber lasers, dual-wavelength fiber lasers for the optical generation of microwave and terahertz radiation, development of eye-safe fiber lasers near 2 μm, mid-IR ultrashort pulsed fiber-based lasers, high-power fiber lasers, high-power thulium-doped all-fiber superfluorescent sources, fiber femtosecond pulse amplification techniques, and their applications. The contributed papers cover a broad variety of key fiber laser research areas including recently obtained original results on mode-locked fiber laser, optical amplifier technology, optical waveguide, fiber based sensors, and optical signal processing technology.

We hope you will find this JSTQE Issue on Fiber Lasers to be an interesting and useful reference that will impact, stimulate, and promote further advances in the area of fiber lasers.

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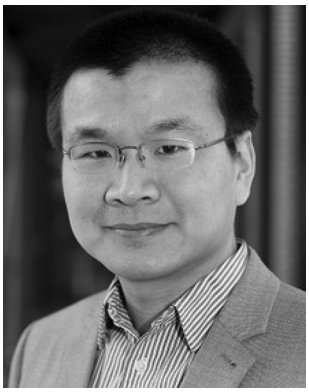

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