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Fiber Lasers and Applications

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Over the last two decades, fiber laser technology had several breakthroughs that turned it into an enabling technology for a large number of applications and research topics. With the fiber optics revolution for telecommunications in the 1980s, fiber optical technology became increasingly more advanced, and higher quality products were achieved. The telecommunications boom in the late 1990s resulted in a dramatic boost to the technical capability of fiber optical technologies and associated optoelectronics. Radical improvements were made in quality, improved lifetime, and reduced price for many components: pump diode lasers, pump coupling devices, beam combiners, rotators, fiber Bragg filters and mirrors, modulators, and detectors. Also, the fibers themselves have seen significant innovation over the last decade, with commercial availability of larger cores for higher power, double-clad fibers for multimode pumping, producing single-mode lasers, and photonic bandgap fibers for even more flexibility of fiber parameters.

The advances in these fiber optical technologies were originally targeted to communication transport applications. Nevertheless, the reliability, compactness, cost, and quality advantages also have merit for creation of novel optical sources for a large variety of industrial and medical applications as well as in academic research.

There are nine papers published in this special section. The papers include three categories: (1) Papers based upon lasing from fiber lasers, such as a paper on a fiber laser based upon a semiconductor optical amplifier (SOA) for generating dark pulses; a thulium fiber laser applied for biomedical applications, including ablation of kidney stones; usage of carbon nanotubes for realization of mode locking in ring cavity fiber laser and building solitons; and fiber laser beam combiners using photonic crystal fibers. (2) Usage of fibers for sensing applications, such as a paper on a fiber-based Bragg grating sensors monitor, and one on a Brillouin-based fiber sensor. (3) Comprehensive study of various effects related to fiber lasers and to fibers, such as a paper involving a comparative study of light propagation and single-mode operation in large-mode area fibers; process observation in fiber laser–based selective laser melting; as well as a paper on temporal pulse shaping of fiber lasers.