All-fiber High-Power Yb-doped Fiber Lasers

Dr. Xijia Gu

Time: 1:00-2:00 pm, October 21, 2010
Location: ENG-101

Abstract

As we celebrate the 50th anniversary of the laser, a new disruptive technology is growing rapidly. High power fiber lasers especially the Yb-doped fiber lasers is at the center of this development in the last decade. Fiber laser has many advantages, such as high energy efficient, excellent beam quality, small footprint, compact package and low cost. In this presentation, I will discuss our recent research activities in the development of high power Yb-doped fiber lasers in all-fiber configurations; more specifically, three types of fiber lasers: (1) the high power cw laser; (2) the passively Q-switched laser with a Samarium doped fiber as a saturable absorber and (3) the single polarization fiber laser with a high extinction ratio.

In the cw fiber laser, we achieved an all-fiber design using a 7x1 fiber power combiner. We obtained an output power of 20W, a narrow spectral width of 0.19 nm, an optical-signal-to-noise ratio of >65dB and a slope efficiency of 76%. The output power can be easily scaled up to 40W, limited only by the power handling capacity of the power combiner currently used.

In the design of a compact, efficient all-fiber Q-switched Yb-doped fiber laser, we used Samarium doped fiber as a saturable absorber. An average output power of 3.4W at a repetition rate of 250 kHz and a pulse width of 1.1 μs was obtained at a pump power of 9.0 W. We also observed mode-locked pulses within the Q-switched pulse envelope with a pulse width of 15 ns and a pulse duration 115 ns that gives a peak power of over 200W.

In the development of the fiber laser with a single polarization output, we achieve a high extinction ratio by the use of a fiber Bragg grating inscribed on a single-polarization fiber. The fiber laser operates at 1063.25 nm with an output power of 2.43 W at a pump power of 5.0 W, an optical signal- to-noise ratio of 70 dB and a narrow bandwidth of 54 pm. The laser emission has a polarization extinction ratio of 700:1 or 28dB and has a very stable power output.

The other topics involving all-fiber design, such as the fabrication of fiber Bragg grating in the large-mode-area double-cladding fiber, the development of pico-second all-fiber laser will also be discussed.
Biography of Speaker

Xijia Gu is a professor in the Department of Electrical and Computer Engineering, Ryerson University. He received his B.Sc. degree from Nankai University, Tianjin, China, in 1982, the M.Sc. degree from the University of Toronto, Toronto, Canada, in 1984, and the Ph.D. degree from the University of Waterloo, Waterloo, Canada, in 1987. He worked as a Research Fellow at Max-Planck-Institute fuer Stromungsforschung, Goettingen, German, and the University of Toronto between 1987 and 1990. Then, he joined Photonics Research Ontario, six years as a Staff Scientist and three years as a Manager, involved in many research projects related to lasers and laser applications. In 1999, he joined JDS Uniphase as a Senior Manager, developed many fiber products for telecommunication such as: fiber grating filters, DWDM modules, and tunable filters. In 2003, he joined Department of Electrical and Computer Engineering, Ryerson University as an associate Professor. He has published 56 referred journal articles, 22 conference papers, and holds four patents. His current research includes high-power fiber laser, fiber-optic devices and modules and fiber-optic sensors.