Optoelectronics and Semiconductor Group
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Field of study: Semiconductor Lasers and Amplifiers, Fiber Light Sources and Amplifiers, Biophotonics, Optical Communications
Key words: High-Power Semiconductor Lasers, Monolithic MOPA (Master-Oscillator Power-Amplifier), Crystal Fibers
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1. The Subject and Aims of Research

Recent research aims at developing advanced light sources for applications in biophotonics, optical communications, solid-state lighting, etc. Recent projects are focused on developing infrared broadband light sources for bio-medical imaging. Separate approaches from two material systems: semiconductor and crystal fiber, would be performed and compared

2. Related Recent Research Topics

(1) High-Power Super-Luminescent Diodes (SLD)

High-power SLD can be applied in numerous fields including solid-state lighting and biophotonics. With many years of industrial experiences on high-power high-brightness semiconductor lasers, making high-power SLD would be an interesting topic. Figure 1 shows an edge-emitting laser diode on submount previously made at SDL. Different wafer and device designs will be used for infrared broadband high-power SLD.

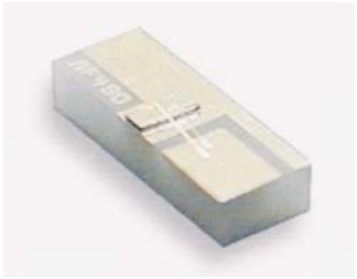

Fig.1. A laser diode on submount

(2) Crystal Fiber Broadband Light Sources

Some single crystals have certain optical properties that traditional glass fibers or semiconductor laser materials cannot offer. When such crystal is grown into a crystal fiber compatible with standard fiber-optic components, new-function and all-fiber light sources can then be realized. Figure 2 shows a double-clad Cr:YAG crystal fiber grown by laser heated pedestal growth system. Different crystals will be used for different applications.

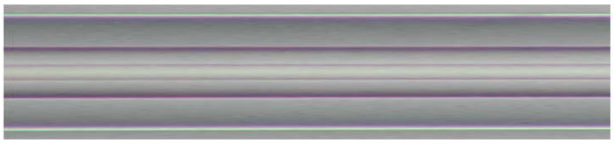

Fig.2. Photo of a double-clad Cr:YAG crystal fiber

(3) Crystal Fiber Lasers

Compared to traditional bulk crystal lasers, crystal fiber lasers not only require less pump power and less thermal management, but also provide a compact, portable and robust package with fiber delivery that is basically maintenance-free. The performance of crystal fiber lasers will be first measured by free-space optics as shown on Figure 3. Then the qualified crystal fibers will be fusion spliced with fiber-optic components such as pump/output couplers, fiber gratings, isolators and optical fibers to make all-fiber crystal fiber lasers.

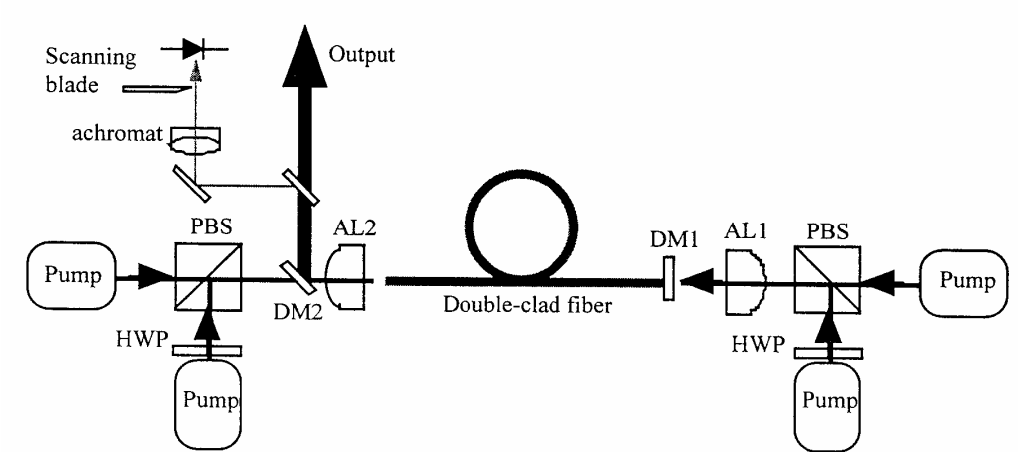

Fig.3. Layout for fiber laser measurement using free-space optics

3. Selected Publications and Projects

Publications:

(1) C. Y. Lo, K. Y. Huang, J. C. Chen, C. Y. Chuang, C. C. Lai, S. L. Huang, Y. S. Lin, and **P. S. Yeh**, "Double-clad Cr^{4+}: YAG crystal fiber amplifier," Optics Letters, V. 30, n. 2, pp. 129-131, 2005.

(2) C. Y. Lo, K. Y. Huang, J. C. Chen, C. Y. Chuang, S. L. Huang, and **P. S. Yeh**, "Super-wideband amplified spontaneous emission generated by double-clad Cr^{4+}: YAG crystal fiber," CLEO'04, Paper CTuS7, May 16~21, 2004 (San Francisco, CA).

(3) V. Dominic, S. MacCormack, R. Waarts, S. Sanders, S. Bicknese, R. Dohle, E. Wolak, **P. S. Yeh**, and E. Zucker, "110W fibre laser," Electron. Lett., V. 35, pp. 1158-1160, 1999.

(4) E. Wolak, S. Bicknese, **P. S. Yeh**, E. Zucker, X. Y. Hong, R. Dohle, and J. Endriz, "Novel high brightness diode laser source," CLEO'99, Paper CMI2, May 23-28, 1999 (Baltimore, MD).

(5) **P. S. Yeh**, I-F. Wu, S. Jiang and M. Dagenais, "High-power high-gain monolithically integrated pre-amplifier/power amplifier," Electronics Letters, V. 29, n. 22, pp. 1981-1983, 1993.

Projects:

(1) "Super Broadband Gain Medium for Next-Generation Optical Communications," USA National Science Foundation (NSF) Small Business Innovation Research (SBIR) award (2003)

(2) "Coarse Wavelength Division Multiplexing (CWDM) Full-Spectrum Clad-Pumped Chromium Doped Fiber Amplifier," USA NSF SBIR award (2005)

(3) "Novel 1.25 μm Source for Micron-Level-Resolution Optical Coherence Tomography," USA National Institutes of Health (NIH) SBIR award (2006)