Triple Ridge Waveguide Laser (2020-035)

A high-power, single transverse mode, edge-emitting diode laser, constructed using a triple-ridge waveguide (TRW) structure.

Market Overview

High-power semiconductor lasers that operate in the fundamental spatial mode are highly desired in a broad number of applications like optical communication, laser surgery, and more. An index-guided ridge waveguide (RW) structure is used to maintain single-mode operation in a transverse direction. Normally, these RW lasers will suppress or cut-off higher-order modes which leads to high power density operation and poor heat dissipation. More so, the maximum available output power from RW lasers is limited and the waveguide structures are susceptible to several degradations. There is a need in the market to introduce additional mechanisms in RW laser structures to avoid the onset of higher-order modes and simultaneously obtain high power. Clemson University researchers have developed a TRW laser structure that consists of a broad-ridge waveguide to provide dissipative modes that can couple with higher-order modes. This laser can effectively suppress all the undesired higher-order transverse modes under a threshold, ensuring single-mode operation with a larger emitting aperture and a higher output power than traditional RW lasers.

Technical Summary

The proposed TRW structure achieves single-transverse mode lasing and high output power simultaneously through equipping the multimode active main waveguide with a pair of lossy auxiliary waveguides. The real parts of the propagation indices of the guided modes, supported by the auxiliary waveguides, are engineered to match with those of the higher-order modes supported by the main waveguide. By appropriately selecting the coupling coefficient (which can be controlled by adjusting the separation distance between the main and auxiliary waveguide or the etching depth) according to the gain-loss contrast between the main and the auxiliary waveguides, the higher order modes associated with the main waveguide will couple with the dissipative modes provided by the auxiliary waveguides and split into symmetric and anti-symmetric supermode pairs. Owing to the strong loss added in the auxiliary waveguides, the modal losses and accordingly lasing thresholds of the higher-order modes are significantly increased.

Application

Laser Cutting & Welding, Laser Surgery, Spectroscopy, Integrated Optical Systems, Fiber Communication Systems

Development Stage

Patent

Advantages

- Capable of single-mode operation without the expense of increasing the threshold current
- Easier to couple the laser beam out with higher alignment tolerance
- Capable of low cost and mass production

App Type	Country	Serial No.	Patent No.	CURF Ref. No.	Inventors
N/A	United States	63/183,173	N/A	2020-035	Lin Zhu Xiaolei Zhao Yeyu Zhu

About the Inventors

Dr. Lin Zhu

Professor and Chair of Electrical and Computer Engineering at Clemson University

Dr. Lin Zhu received his Ph.D. in Electrical Engineering from the California Institute of Technology in 2008 where he worked on the modal control of high power and broad area semiconductor lasers. Dr. Zhu's current research areas are nanophotonics, hybrid integration of optical devices and systems, and high power solid-state and fiber lasers. He has received the DARPA Young Faculty Award and has been funded by many federal and state agencies.

For more information on this technology contact:

Andy Bluvas
Technology Commercialization Officer
E: bluvasa@clemson.edu
P: (864) 656-0797