UNIVERSITI TEKNOLOGI MARA

MULTIWAVELENGTH LASER UTILIZING MACH-ZEHNDER INTERFEROMETER IN HYBRID RAMAN EDF GAIN MEDIUM

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

This project demonstrates the design of multiwavelength laser utilizing Mach-Zehnder interferometer (MZI) in hybrid Raman EDF gains medium to produce the most reliable, low cost, high gain and compatibility multiwavelength laser. The research starts with simulation of multiwavelengthh laser using OptiSystem software and design suite to plan, test, and simulate the optimum optical laser system in different cavity. This simulation also demonstrates various scenario to achieve the ideal gain for single linear laser, bidirectional linear laser and ring laser. From the simulation, the 50% arm coupling ratio of bidirectional linear laser structure with 0.2 nm linewidth, 20 lasing lines and 5 mW lasing threshold is achieved and shown to be the best result for multiwavelength laser design as compared to single pass cavity and bidirectional linear cavity. With an input power of 240 mW (EDFA) and 2000 mW (FRA), 96% power conversion efficiency is obtained. It produced a stable L-band multiwavelength laser with peak power of -10 dBm for bidirectional linear laser, -25 dBm for single pass linear cavity and -5 dBm for bidirectional linear laser. For the experimental part, the design of multiwavelength fiber laser utilizing tapered EDF based MZI in hybrid Raman-EDF gains design with a bidirectional linear cavity has been conducted. Bidirectional linear cavity was chosen from the simulation result. Stable laser was obtained from the single pump with a 1497 nm wavelength through the employment of a 20:80 optical circulators and 99% reflective mirror. The hybrid Raman-EDF gain is pumped from the external cavity by a Raman Pump Unit (RPU) and produced a stable multiwavelength laser output at 90% coupling ratio with Side Mode Suppression Ratio (SMSR) of 28.9 dBm for 300 mW pump power, 30.7 dBm for 1000 mW pump power and 33.7 dBm for 1500 mW pump power. The generated backward-propagating oscillates inside the laser cavity generate a stable multiwavelength output with 4 channels, which is coupled out via the 10/90 coupler and the output laser is characterized using an OSA with resolution of 0.015 nm. The advantage of the proposed multiwavelength laser is high SMSR, high number of channels, low threshold power and high pump conversion efficiency.

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