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Design of a Fiber Laser in Optical Telecommunication Systems

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ABSTRACT

Nowadays, Fiber lasers are of great interest for telecommunications system. In this paper, we study the components used in the design of fiber-optic laser-based telecommunication systems. Fiber lasers can be designed in two configurations: linear cavity and ring cavity.

1. INTRODUCTION

Fiber lasers have gained tremendous interest for applications in optical telecommunication systems as potential compatible laser sources with high output powers and narrow linewidths. One of the important driving forces behind the development of active laser devices is the realization of a new class of laser sources. Fiber lasers, as active devices, are the most recent major activity in glass lasers. Fiber lasers are achieved using silica glass fibers a gain medium. Glass fiber contains a high refractive index core, surrounded by a lower refractive index cladding layer. Glass is suitable for the laser host because of its optical quality, transparency, low birefringence, high optical damage threshold, thermal shock resistance, weak refractive index nonlinearity, high energy storage and power extraction capacities, size and shape scalability and low cost of raw materials. These devices offer promise as significant components for use in the telecommunications and sensing industry [1-4].

2. EXPLANATION AND BLOCK DIAGRAM

Generally, a fiber laser consists of a gain medium within the fiber resonator. Fiber laser can be realized in two configurations: linear cavity and ring cavity. A typical design of a fiber laser is based on the linear configuration (the standing wave linear cavity or Fabry-Perot cavity) as shown in Figure (1).

In contrast to a standing-wave laser resonator, the travelling ring resonator in the form of a ring allows for two different propagation directions of the intracavity light. In a ring configuration as shown in Figure (2), the direction of the laser light is made to flow in a unidirectional manner. This is achieved by inserting an optical isolator inside the ring cavity.

Also, by making the flow of laser unidirectional, the system eliminates the chances of the two counter propagating laser signal waves interfering with each other that will result in standing waves. These standing waves will then induce a ‘Spatial Hole Burning’ in the fiber laser gain which allows the oscillation of many longitudinal cavity modes [5-7].

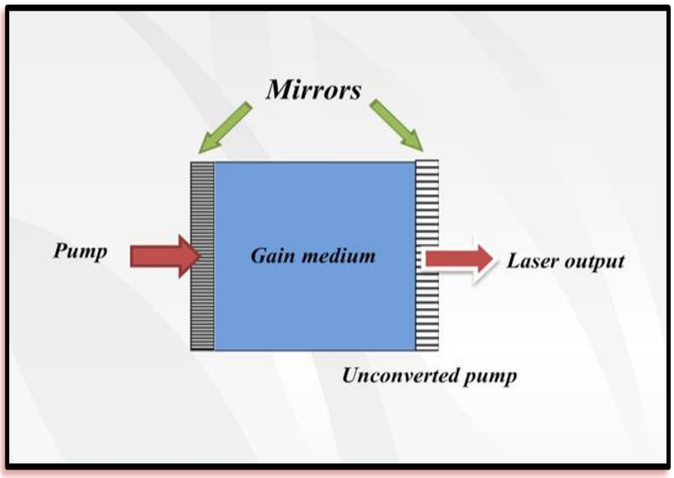

Fig.1. Schematic representation of linear (Fabry-Perot) cavity fiber laser.

As a result of the inclusion of an isolator, this problem can be overcome and the fiber laser can produce a single longitudinal mode laser output. Ring configuration allows mirror-free operation and integration of the component.

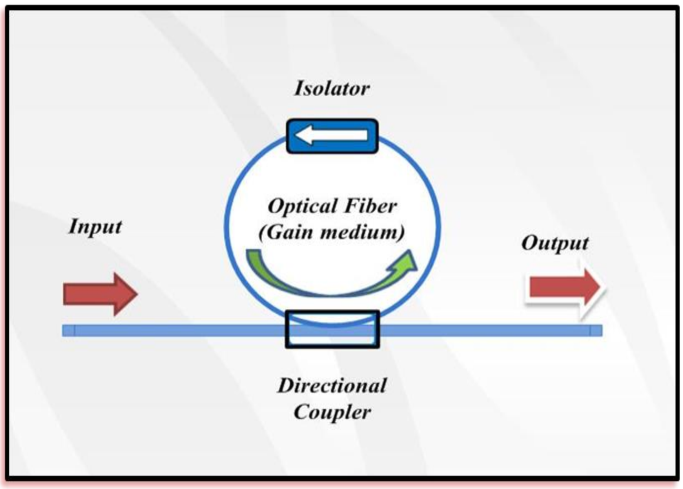

Fig. 2. Schematic diagram of a fiber ring laser.

Volume 1, Issue 3, Pages 226-227, April 2017

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