Active Mode Locking in Laser Gyroscope on Semiconductor Optical Amplifiers and Long Fiber Cavity

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Abstract—In this paper we present the results of research on generation regimes in laser gyroscope on semiconductor optical amplifiers with the use of long fiber cavities. Physical-mathematical model of generation dynamics has been made. This model describes processes in the gyroscope on semiconductor optical amplifier and external fiber cavity. The study of the competition and intercoupling degree of the counterpropagating waves has been conducted.

Keywords—Active mode locking, semiconductor optical amplifiers, laser gyroscope, optical fiber.

Laser gyroscope on semiconductor optical amplifier [1-2] with the use of fiber cavities has a variety of advantages in comparison with other gyroscopes. These advantages are pumping by electric current, small sizes, long life time and the possibility of mass production. The use of fiber cavity in gyroscope allows to change optical contour and, consequently, to manipulate the gyroscope's sensitivity. Registration of signal is occurred by means of resolving the spectrum of longitudinal counter wave beatings. Mode-locking in such gyroscope can essentially reduce the longitudinal mode beating spectral line width and thus increase sensitivity. Therefore the characteristics of a laser gyroscope with the semiconductor optical amplifier, working in a mode-locking regime have been studied in this work (fig.1-2). The amplifier SOA-1550-14BF for central wavelength of 1530 nm with a fiber input and the output providing conservation of polarization was used. The gain peaked at 20 dB. The "Pande" type PM – single mode fiber used in the resonator, provided the conservation of polarization. The amplifier is based on quantum-dimensional heteroepitaxial structures on InGaAsP-InP with five quantum dots. The ultra long length of an optical contour of the laser leads to a small interval on frequency between longitudinal modes. So, at length of the cavity of 870 m longitudinal modes will shift from each other on frequency on 234.7 kHz. Mode-locking was reached by modulation of a pump current on frequency corresponding to the interval between modes on frequency. For detecting counter waves beatings the signal on the semiconductor optical amplifier with use of the synchronous amplifier and the phase detector was registered. For adjustment of the laser and the control of signals the 50 % optical mixer was used on which output the signal beatings counter waves InGaAs by the photo diode with a fiber pigtails input was registered. Investigations of stability a mode-locking at rotation of a gyroscope on experimental setup have been carried out. Characteristics of the response of a signal on the optical amplifier of a gyroscope on rotation are obtained.

In work the physical and mathematical model describing processes of generation and mode-locking in a gyroscope on the basis of the semiconductor optical amplifier and the external fiber resonator is made. The study of the competition and intercoupling degree of the counterpropagating waves has been conducted. The optimal operation regimes providing registration of rotation are determined.

Our investigations show essential reduction of spectral width beatings longitudinal modes at their synchronization that improves sensitivity and the opportunity of detecting the rotation on signal beatings the counter waves, registered on the semiconductor amplifier. As a whole, the gyroscope on the semiconductor optical amplifier with the fiber cavity has shown the opportunity of registration of rotation and its use as the sensor of low accuracy.

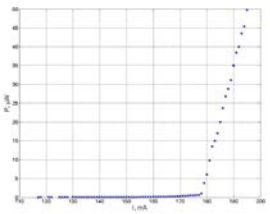

Fig. 1. The dependence of generation power.

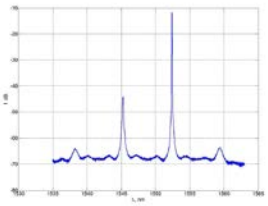

Fig. 2. Spectrum of laser generation.

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