

New generation fiber optic gyroscopes

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The work presents research on the operation of a fiber-optic gyroscope. It consists of the following components: a superluminescent laser diode (wavelength 1550 nm), a circulator, a splitter, a phase modulator, and a 500-meter optical fiber coil (fiber type: Panda). Figure 1 illustrates the operation of this gyroscope [1], which meets the average accuracy metrics of existing analogs. However, there are currently active developments and implementations of photonic crystal fibers (PCF) and polarization-maintaining optical fibers (PANDA), which possess a range of attractive properties for use in fiber-optic gyroscopes: fully integrated construction, fiber length around one meter, no need for fiber winding on a spool, and a compact device. PCFs have a complex structure that affects their properties as photonic crystals (PC). Depending on the width of the photonic bandgap, PCFs can be classified as conductors, insulators, semiconductors, or superconductors for electromagnetic waves. Conductors have broad allowed

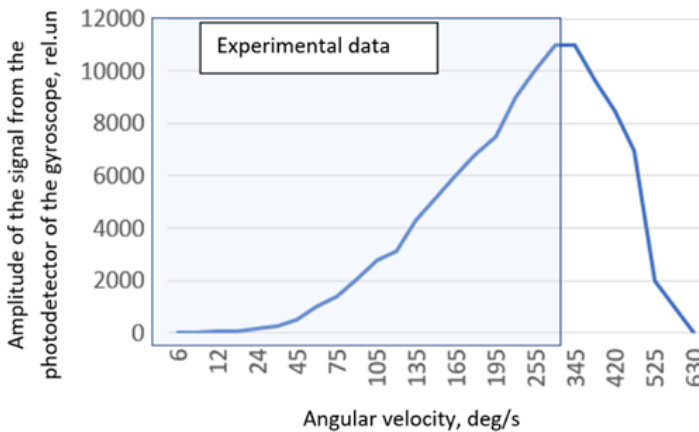


Fig. 1

bands for light propagation with minimal absorption, while insulators have

wide forbidden bands and act as ideal mirrors with no light absorption. Semiconductors can selectively reflect photons of certain wavelengths. The hollow core of PCFs and PANDA-type fibers offer advantages over standard optical fibers: operation in a single-mode regime over a broad wavelength range, ability to handle intense radiation, larger mode area, low optical nonlinearity, precise dispersion control, and anomalous dispersion of the waveguide with high steepness through Rayleigh scattering. Additionally, the use of photonic crystal fibers allows for the implementation of a fiber-optic gyroscope based on supercontinuum generation [2]. These studies are being conducted by the team presented in this work.

References

- [1] Hnatenko, O.S., Machekhin, Y.P., Bilichenko, V., Zarytskyi, V.I., Yaroslavskyy, Y., Klimek, J., Mussabekov, K., Yeraliyeva, B., Ormanbekova, A. FIBER-OPTIC SYSTEM FOR CONTROL OF THE ORIENTATION OF OBJECTS IN SPACE (2023) Proceedings of SPIE - The International Society for Optical Engineering, 12985, art. no.1298508. DOI: 10.1117/12.3023026.
- [2] Kurskoy, Y.S., Hnatenko, O.S., Afanasieva, O.V. Application of Supercontinuum in Optical Gyroscopy (2023) Journal of Nano- and Electronic Physics, 15 (6), art. no. 06023. DOI: 10.21272/jnep.15(6).06023.