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AMPLITUDE-TYPE SENSORS IN FIBER-OPTIC DEVICES

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This article discusses some of the sensors used in fiber-optic devices. The advantages of their use are analyzed. The principles of operation of some sensors are shown.

The material of fiber-optic sensors (FOS) is a dielectric. FOSs do not require electrical power and grounding [1], therefore they can be used in explosive environments without the risk of an electric spark; they offer good accuracy and performance; they may have a small size (up to 0.1 cm2 for a Bragg sensor); they have low cost, with the possibility to be placed at a far distance from the recording equipment. Modern fiber-optic sensors can measure pressure, temperature, strain, liquid level, gas concentration , radiation dose, and more.

Physical effects on the optical fiber, such as temperature, pressure, and tension force, locally change the characteristics of light transmission and, as a result, lead to changes in the characteristics of the back reflection signal. Measurement systems based on fiber-optic sensors are based on comparing the spectra and intensities of the original laser radiation and radiation scattered in the opposite direction after passing through the fiber.

The so-called Raman effect is particularly suitable for measuring temperature using light guides made of quartz glass. Light in a glass fiber is scattered by microscopically small density fluctuations that are smaller than the wavelength. In contrast to incoming light, backscattered light contains both a component with an initial wavelength (due to elastic or Rayleigh scattering)and components that have undergone a spectral shift to a frequency corresponding to the resonant frequency of the scattering nodes (Raman Raman scattering). Components with a shifted wavelength form satellite lines in the scattered light spectrum, which are divided into Stokes (shifted to longer wavelengths and lower frequencies) and anti-Stokes (shifted to shorter wavelengths and higher frequencies). The amplitude of the anti-Stokes component depends on the local temperature.[1]

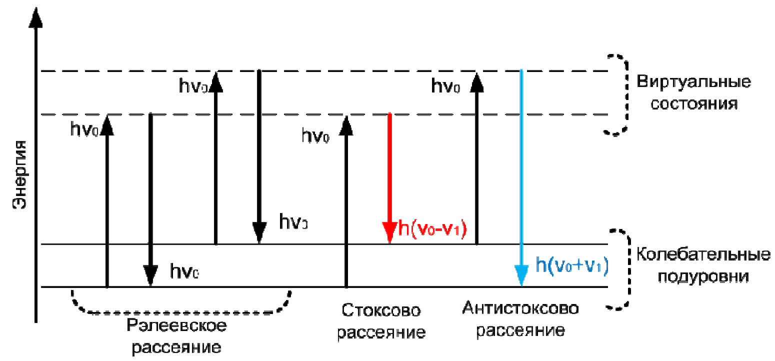

Figure 1. – Rayleigh and Raman light scattering

One of the most popular sensors in the modern manufacturing process is the optical distance sensor. Laser distance sensors are an optoelectronic device for determining the distance to an object. Contactless distance measurement has countless applications. For example, an optical distance sensor is used to determine dimensions (thickness, height, length, width), control the minimum or maximum distance, positioning, level of filling or emptying the tank, and so on.

The optical rangefinder works on one of two basic principles:

1.The principle of measuring the time of flight of the beam. That is, the laser diode of the sensor emits pulses that are reflected from the target (measurement object) and then captured by the photodetector of the same sensor. By measuring the time between the moment of the pulse emission and the moment of its "return", the electronics calculates the distance to the object.

2.The principle of triangulation. The light emitted by the sensor is reflected by the object and then "returned" to the sensor's photodetector. The distance is calculated by determining the phase difference between the sent and received signals. This method is also called the phase measurement method.[2]

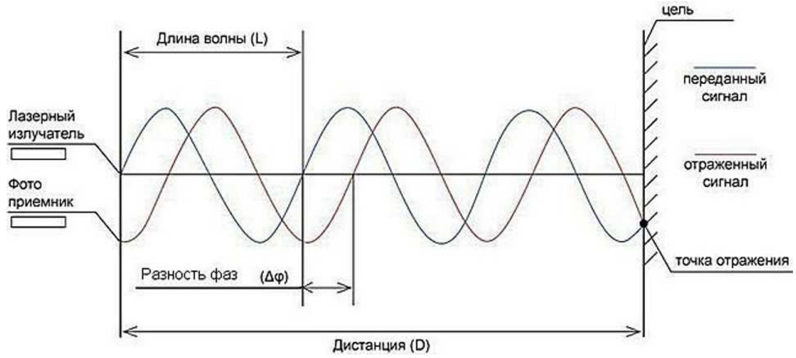

Figure 2. – Principle of operation of the laser rangefinder

REFERENCES

1. Оптические датчики температуры [Электронный ресурс]. – Электронные данные. – Режим доступа: http: // www.nctech.by. - Дата доступа: 13.01.2020.
2. Дальномер [Электронный ресурс]. – Электронные данные. – Режим доступа: https://tehpribory.ru- Дата доступа: 13.01.2020.