Development and Investigation of Mathematical Model of an Optoelectronic Sensor of Methane *Concentration*

Oleksandr Volodymyrovych VOVNA, Ivan Serhiiovych LAKTIONOV, Anatolii Anatoliiovych ZORI, Ramin Nizamiiovych AKHMEDOV

Department of Electronic Engineering, Faculty of Computer-Integrated Technologies, Automatization, Electrical Engineering and Radioelectronics, State Higher Educational Establishment Donetsk National Technical University, Shybankova Square 2, 85300 Pokrovsk, Donetsk region, Ukraine

A mathematical model of a methane concentration sensor has been developed and studied, which takes into account the use of materials with different optical properties in the channel, spectral and spatial adjustment of the sensor components, losses at modulation and signal processing, as well as scattering and absorption of the optical emission flux in the channel. Taking into account results of modeling and experimental studies of the prototype sensor, confirming the adequacy of the proposed model, types of optoelectronic sensor components, as well as its design parameters with allowable deviations in manufacturing, have been substantiated and selected. The emission losses in the optical channel have been minimized when the informative parameter is maximized, which is absorption of optical emission by the measured methane concentration, by providing the length of the sensor measuring channel not more than 30 mm and the use of light and photodiodes with covering of their sensitive elements with chalcogenide glass. It has been established that the main measurement error of methane concentration with the application of these recommendations is not more than 0.04 vol. % with the regulated value of 0.20 vol. % in the range from 0 to 5 vol. %, which significantly exceeds metrological characteristics of the existing prototypes of the methane concentration sensor for coal mine atmosphere.