Measurement of H_2S Ppb-Level Concentration by Field Effect Gas Sensor with a SnO_2-Pd Gate Material

M.O.Etrekova, N.N.Samotaev, A.V.Litvinov

National Research Nuclear University MEPhI, Russia, 115409, Moscow, Kashirskoe shosse 31

MOEtrekova@mephi.ru

The report describes the results of testing a condenser-type field effect (FE) gas sensor for measuring H_2S concentration at the ppb level, which is important for continuous monitoring in the air of a residential area [1]. The proposed method for measuring H_2S using FE gas sensor was developed as an alternative to the use of existing high-precision and sensitive methods (for example, using chemiluminescence sensors), which are both complicated and expensive to implement. For increasing sensitivity compare with classical FE gas sensor with Pd gate the SnO_2-Pd material is used as a gas-sensitive material for the sensor gate. Experimental measurements show a significant (about 2 times) increase in sensitivity of the new approach using MOX material. The conclusions about the sensors' sensitivity under study were made on the basis of direct measurements using an upgraded thermal diffusion gas mixing plant and a source of hydrogen sulfide microflow (Fig.1a). An example of measuring H_2S ppb-level concentrations with a FE gas sensor is shown in Fig.1b, which also experimentally confirmed the possibility of detecting 4 ppb H_2S with a signal-to-noise ratio of at least 10. The stable concentration generation at the first ppb-level required us to significantly upgrade the instruments that are used for standard experiments with MOX sensors, that are present on Fig.1a. In our opinion, the advantage of the used FE gas sensor is due to the fact that at low operating temperatures there is little probability of the secondary chemical compounds formation when the target gas interacts with the sensitive material (the temperature is insufficient for a stable chemical reaction), which significantly saves the service life of the sensitive element and contributes to long-term stability of its characteristics. The FE gas sensor signal is only associated with the charge in changes generated by the gas at the gate / dielectric interface, which affect the measured capacitance of the MIS structure [2]. The relatively long decay and rise of the signal is associated with diffusion in the solid structure of the MIS structure's gate and adsorption processes at the gate / dielectric interface.

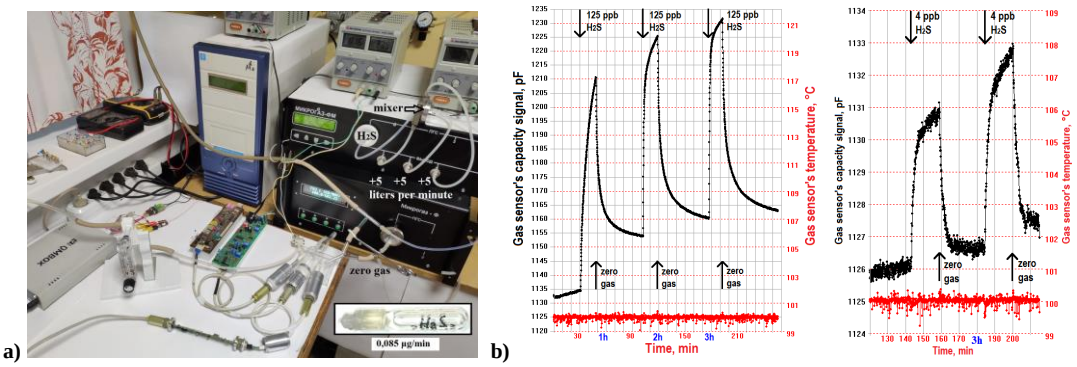

Fig. 1. Photo of an installation for generation of low concentrations of hydrogen sulfide in air (a). The sensor's response to the inlet and discharge of the 125 and 4 ppb H_2S concentrations (b)

[1] Russian Sanitary rules and regulations 1.2.3685-21 at https://docs.cntd.ru/document/573500115.
[2] A.V. Litvinov, N.N. Samotaev, M.O. Etrekova, Y.A. Klishin, N.A. Korolev. Physics of Atomic Nuclei, **82** (11), 2019, pp. 1499-1502.