Non-invasive diagnosis technique is becoming more prominent in diagnosing diseases due to their pain free and simple monitoring methods [1]. Особливо заслуговує увагу використання цієї техніки для визначення ацетону. Acetone can be produced via the fatty acid oxidation in diabetes and ketoacidosis lack of insulin [2]. Excessive acetone circulating in the blood system is excreted from the lung. Проблема його визначення заключається в тому, що higher acetone concentration ranges from 1.7 ppm to 3.7 ppm could be detected in breath for those who are diabetic, while the breath of healthy human typically contains less than 0.8 ppm [3]. Тому, Gas sensors with sub-ppm acetone detection capacity play an important role in the development of non-invasive monitors or early diagnosis of potential diabetic patients [4].

Для виявлення низьких концентрацій газу, в тому числі ацетону, використовували сенсори засновані на методах спектроскопії [5,6] photo-ionization techniques [7]. Проте їх почали витісняти більш зручні газові датчики, такі як electrical sensor (electronic nose) [8,9], датчики для визначення acetone low concentrations на основі semiconductor metal oxide gas sensors [10, 11]. Table 1 shows the summary of the literature review of the selected semiconductor/ metal-oxide based sensors for acetone detection в умовах низької концентрації.

Таблица 1. Acetone sensing properties for various semiconductor/ metal-oxide based sensors в умовах низької концентрації.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Material | Principle of Operation Device Type | Lowest Concentration Detected (ppm) | Response Time | Operation Temperature, °C | Ссылка |
| InN | Resistance (voltage) change Thin Film | 0.4 ppm | 1,090 s | 150 | [4] |
| SnO2 | Resistance (voltage) change Thin Film | 1 ppm | 3.33 | 180 | [12] |
| SnO2–TiO2 | Resistance (voltage) change Thin Film | 7.5 | 60 | 200 | [13] |
| Ru/WO3 | Resistance (voltage) change  nanoparticles | 0.5 | 7.3 Ra/R | 300 | [14] |
| SnO2/SiO2 | Resistance (voltage) change Thin Film | 0.5 | 2193.7 Ra/Rg | 70 | [15] |
| SnO2 thin ﬁlm | Resistance (voltage) change Thin Film | 8 | 19 | room temperatur | [16] |

Ra/Rg—electricalresistanceunderexposuretoairandtargetgas(acetone),respectively.

Among the semiconductor metal oxides used in gas sensors, SnO2 has received considerable attention in science and technology for many years. The maximum response R = Ra/Rg (where Ra and Rg are electrical resistance in air and in gas, respectively) equaled 20.18 measured at 300 ◦C under 50 ppm of acetone [17]. Another group [18] have proposed acetone sensors based on 2D C3N4-SnO2. The sensor response was deﬁned as Vg/Va, where Vg and Va are electrical voltages measured under exposure to gas and air, respectively. The highest responses were obtained at 380◦C, for 20 ppm acetone was around 11 and limit of detection was measured around 87 ppm. Yanping Chen observed that the sensing response increases when the concentration of acetone increases from 5 to 50 ppm. After injection of 5 ppm, 10 ppm, 20 ppm, and 50 ppm acetone, the response of the sensor increased abruptly, corresponding to the responses of 5.043, 7.221, 10.6, and 16.898, respectively [19].

Починаючи з 1983 року активно почали вивчати сенсори на основі полімеру [20]. In comparison with most of the commercially available sensors, based usually on metal oxides and operated at high temperatures, the sensors made of conducting polymers have many improved characteristics [21]. They have high sensitivities and short response time; especially, these feathers are ensured at room temperature. Conducting polymers are easy to be synthesized through chemical or electrochemical processes, and their molecular chain structure can be modified conveniently by copolymerization or structural derivations. Furthermore, conducting polymers have good mechanical properties, which allow a facile fabrication of sensors [22, 23]. The conducting polymer channel is usually made of poly (3,4-ethylenedioxythiophene) doped with poly (styrene sulfonate)(PEDOT:PSS),a benchmark material that is commercially available and stable in aqueous medium [24]. Сенсори на основі PEDOT:PSS/PVP nanofibers осліджували начутливість до CO gas. Показано, що PEDOT:PSS/PVP nanofiber membrane was sensitive to low concentration(5–50ppm) CO gas при відгуку 50 с.[25]. Yotsarayuth Seekaew presents a simple, low-cost and practical inkjet-printing technique for fabricating an innovative flexible gas sensor made of graphene–poly(3,4-ethylenedioxythio-phene):poly(styrenesulfonate) (PEDOT:PSS) composite film [26]. The ink-jet printed graphene–PEDOT:PSS gas sensor exhibits high response and high selectivity to NH3 in a low concentration range of 25–1000 ppm at room temperature. (PEDOT/PSS)-based nanowires sensors were exposed to methanol, ethanol and acetone vapor. The nanowire shows rapid (∼30 s), reversible responses to all three analytes, and rapid recovery to baseline when exposed to air. A polymer conductivity of 11.5 ± 0.7 S cm−1 and a contact resistance of 27.6 ± 4 k were inferred [27]

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