APPLICATION OF GAS SENSORS FOR THE QUALITY CONTROL OF FOOD PRODUCTS

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Semiconductor sensors represent an independent class of analytical devices and permit to get reliable, rapid and easily processed information. Their use gives the possibility of control, diagnostics and management of different processes, as well as the possibility of analysis of raw material and finished product quality indicators. The application of semiconductors in this field can be quite perspective, especially when dealing with control efficiency, sample preparation and analysis cheapness.

Rapid and precise quality control of different products and goods can be provided by the qualitative and quantitative identification of not only chemical composition of the products, but also their "smells", i.e. by identification and measurement of the concentration of gas environment, created by the analysis objects in the surrounding atmosphere [1-4].

During the fish storage, even if frozen, the fish quality decreases because of the autolytic oxidation and protein destruction, followed by the emission of threemethylamine gas and other substances. The indication of the fish freshness and her storage term can be realized by the identification of the concentration of the threemethylamine, emitted by the sample. The process of microbiological spoiling of meat and meat products is accompanied by the decomposition of amino acid and by the emission of light-end and volatile products: sulphuretted hydrogen, mercaptan ammonia. Consequently, defining the quality of the emitted gases or one of them, for example, sulphuretted hydrogen, we can judge about the quality of the tested meat products.

The investigation on the application of semiconductor sensors for the diagnostics of the condition of perishable raw food products has been carried out on the samples of raw herring and raw low-fat pork. Thin SnO_x films of high sensitivity to a range of gases (threemethylamine, alcohol, sulphuretted hydrogen, ammonia) but of low selectivity were used as the sensitive sensor elements. The temperature of the sensitive sensor elements during the diagnostics of herring freshness was held at the level of maximal sensitivity to thremethylamine (300°C), and during the diagnostics of pork freshness – at the level of maximal sensitivity to sulphuretted hydrogen (200°C). By such a method of measurement high sensor selectivity to gases is of no need.

The samples of the products tested, 5 grams each, were put into the measuring glass chamber, 750 ml in volume, with a sensor within. To get the equilibrium value of the concentrations, emitted from the gas samples in the measuring chamber, the system was held during 15-20 minutes, after which the adsorption sensor response ($S = \sigma_{gas}/\sigma_{air}$) was measured. As the output signal, the change in the conductivity of the sensitive element in gas presence was measured.

In order to reveal the functional dependence between the sensor signal and the sample condition, the samples of raw herring and meat were held at the room temperature till the organoleptic symptoms of spoiling appear, and in definite spells of time the sensor response to the smell were measured.

Obviously, that the sensitive sensor element reacts not to the separate component of the sample smell, but to all of them, but with a different response degree to each of them. However, the emission of just the prevailing sample gas component determines the major response degree, which defines the condition of the product.

In fig. 1 (a) there is a curve of sensor signal change, reacting to the smell of herring samples and depending on the storage term at the room temperature. The signal, when the storage term of the samples is less than 20 hours, changes insignificantly, and then the process of fish spoiling progresses dramatically, which leads to the rise in the sensor response value.

The curve of the sensor signal change, reacting on the smell of the pork samples and depending on the storage term at the room temperature, is shown in fig. 1 (b). The picture shows that already after 10 hours of the meat samples storage at the room temperature the processes of the microbiological spoiling begin to progress dramatically, which changes the sensor response degree.

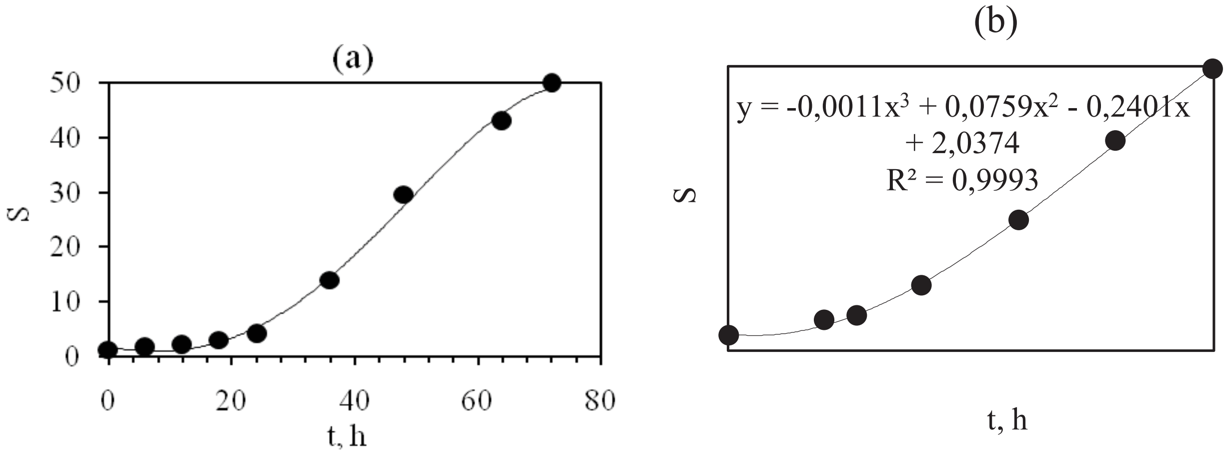

Fig. 1. The curves of the sensor signal changes, reacting on the smell of herring (a) and pork (b) samples and depending on the storage term

The experimental curves of the sensor signal, depending on the storage term of the herring and pork samples have resembling dependence, which obey exponential equations on their first stages of signal growth. These equations are correct for the curve segments to 45 hours, if it is herring, and to 24 hours if it is pork. Then the sensor signal change is insignificant. It can be explained by the fact, that by the long sample storage the amount of emitted gas is so great, that the sensor response tends to saturation, i.e. reaches the maximal level of the adsorption response. However, these dependence segments show the signal an already spoiled product, and for the practical diagnostics and prognostication of the microbiological sample condition the initial curve segments can be used.

The carried-out investigations showed that the application of the semiconductor sensors permits rapidly and precisely in comparison with organoleptic and other control methods to identify the condition of fish and meat products. The application of the sensors opens up the possibility rapidly to prognosticate the condition of perishable products and to estimate the time of product safety till it is spoiled.

References

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