Electrochemical Gas-Sensor For Methyl Mercaptan Vapor

Takeshi MINAMIDE[1], Kohji MITSUBAYASHI[2], Hirokazu SAITO[2] and Genki NISHIO[1]
[1]Graduate School of Engineering, Tokai University, Hiratsuka, Kanagawa 259-1292, Japan
[2]Department of Biomedical Devices and Instrumentation, Institute of Biomaterials and Bioengineering, Tokyo Medical and Dental University, Kanda-Surugadai, Chiyoda-ku, Tokyo 101-0062, Japan

Halitosis diagnosis is important in the medical and dental fields. It is caused by Methyl mercaptan (MM). So it is considered that measurement for MM gas with convenience and high gas-selectivity can apply halitosis diagnosis [1]. Meanwhile, a monoamine oxidase type-A (MAO-A, one of xenobiotic metabolizing enzymes) is reported to catalyze the oxidation of the organic compounds which has thiol and amino, including MM, in human liver [2]. In this study, MAO-A biochemical sensor for MM in the liquid and gas phase were constructed and their characteristics were evaluated.

The MM biosensor was fabricated by a Clark-type oxygen electrode and the MAO-A immobilized membrane. The MAO-A membrane was cut, and placed onto the sensing area of the dissolved oxygen electrode with a cover of supporting nylon net secured by a silicone O-ring. The tip of the enzyme electrode was immersed phosphate buffer solution. L-ascorbic acid (AsA) was applied to the buffer solution in order to generate the substrate regeneration cycle caused by coupling the MAO-A with the reducing reagent system to amplify the sensor output [3].

The behavior of the biosensor was evaluated by using MM solutions in a batch flow measurement. The sensor output of oxygen consumption induced by MAO-A enzymatic reaction was monitored by a personal computer via A/D converter. And then, the biosensor was applied to measure MM vapor as a biochemical gas-sensor (bio-sniffer system). In this system, the enzyme electrode was fabricated with reaction cells with gaseous and liquid compartments separated by a porous membrane. The tip of the enzyme electrode was immersed in the liquid compartment. The enzyme electrode could detect the MM vapor permeated to the enzyme membrane through the porous diaphragm membrane.

Typical response curve of the MAO-A biosensor was observed by injection MM solution. The sensor outputs were related to the concentrations of MM solution with gas selectivity attributable to the substrate specificity of MAO-A. By the measurement of MM vapor using the bio-sniffer, the sensor outputs were also related to the concentrations of MM vapor. The calibration range of the bio-sniffer for MM vapor included the human sense of smell level 5 (0.2 ppm). Consequently it was suggested that the MAO-A bio-sniffer would be applicable to analyze the halitosis in the near future.

REFERENCES

[1] J. Rodriguez-Fernandez, et al., *Talanta*, **62**, 421-426 (2004).
[2] R. McCauley, E. Raeker, *Arch. Biochem. Biophys*., **1**, 73 (1971).
[3] Y. Hasebe, *Chemical Sensors*, **14**, 3 (1998). 901-903 (2000).