A Gas-Phase Biosensor For Lactate Vapor

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Lactate has detergent activity for home use, i.e. for washing bathroom, coffee machine, etc. However, at higher concentration, its hazardous nature on public health, i.e. skin irritation, nausea, bleary eyes, has been widely known. The convenient assessment approach has been required in several kinds of fields [1].

In this research, biosensors for odorless lactate in the liquid and gas phases were developed by using lactate oxidase, and their characteristics were evaluated in the batch measurement systems in the liquid and gas phases, respectively.

The enzyme electrode was constituted a commercially available Clark-type dissolved oxygen electrode with an enzyme membrane. Lactate oxidase (LOD, EC1.1.3.2,) was used for constructing the enzyme electrode. The enzyme catalyzes specificity for lactate, thus consuming oxygen molecule as one of enzyme substrates

For enzyme immobilization, LOD was mixed with PVA-SbQ monomer solution (photocrosslinkable polyvinyl alcohol containing stilbazole quaternized; Type: SPP(styryl pyridinium polymer)-H-13(Bio)) in a weight ratio of 1 : 320, to a dialysis membrane (thickness: 15 μm) spread on a glass plate, and then irradiated with a fluorescent lamp for 1 hour in order to photocrosslink the monomer solution and immobilize the enzyme into the dialysis membrane. The enzyme electrode was fabricated by cutting the enzyme membrane to the required dimensions using a scalpel and placing it onto the sensing area of the dissolved oxygen electrode. The enzyme membrane was secured with a rubber O-ring.

After the evaluation of the sensor behavior in the liquid phase, the LOD immobilized sensor was used in a batch measurement system with varying concentration of lactate in the gas phase. A computer controlled potentiostat was electrically connected to the bio-sniffer. A fixed voltage of -700 mV vs. Ag/AgCl was applied to the platinum working electrode of the dissolved oxygen electrode. The output current was monitored graphically on a continuous computer display and saved for later analysis.

After evaluating the characteristics of the LOD immobilized sensor in the liquid phase, the biosensor was used for the lactate measurement in the gas phase. The output current of the sensor increased rapidly following application of lactate standard vapor, and reached to the steady state value. The steady output of the lactate gas-sensor was related to the concentration of lactate (from 0.5 ppm) in the gas phase. This biochemical sensor gave negligible responses to other chemicals in the gas phase, thus indicating high gas selectivity for lactate attributable to the substrate specificity of LOD.

REFERENCES

[1] TAP H, et al., Sens Actuators B, B68, 123 (2000).