

Study of Halitosis-Substance Sensing at Low Concentration Using an Electrochemical Sensor Array Combined with a Preconcentrator

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A method for quantitative detection and discrimination of volatile sulfur compounds (VSCs) using an electrochemical sensor array combined with a preconcentrator was proposed. Halitosis is due to VSCs produced by bacterial metabolism. An organoleptic test is typically performed by a dental clinician for the assessment of halitosis, although it is a subjective test. Thus, an objective evaluation of halitosis is required.

The experimental setup of the measurement system is shown in Fig. 1. The air pump was used to suck the sample vapor in the sampling bag via the preconcentrator (path1 in Fig. 1). The preconcentrator was heated, and thermally desorbed vapor from the preconcentrator flowed into the sensor array via path2 in Fig. 1. We have changed the direction of flow path in sampling stage from the previous study. As a result, the discrimination limit among the three VSCs were improved from 500ppb to 200ppb,

which is comparable to the concentration level of the oral malodor.

Moreover, two MFCs were added between the preconcentrator and the sampling bags to measure mixed components of VSCs. We chose H₂S and CH₃SH for mixture measurement of VSCs. Mixtures of two VSC vapors (H₂S and CH₃SH) at various mixing ratios were measured. From the results, the mixture compositions of VSCs were almost correctly obtained using partial least squares (PLS) regression analysis. The actual concentrations and the obtained concentrations were well-matched, and their relationships in the case of CH₃SH are shown in Fig. 2.

Thus, the discrimination among the three VSCs over the range between 200ppb and 1000ppb was clearly performed. Furthermore, the concentrations of VSC components in the mixture vapor were obtained using PLS at an acceptable level.

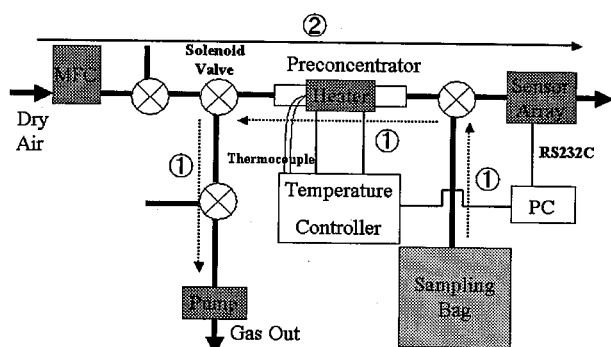


Fig. 1. Schematic diagram of the measurement system for preliminary experiment

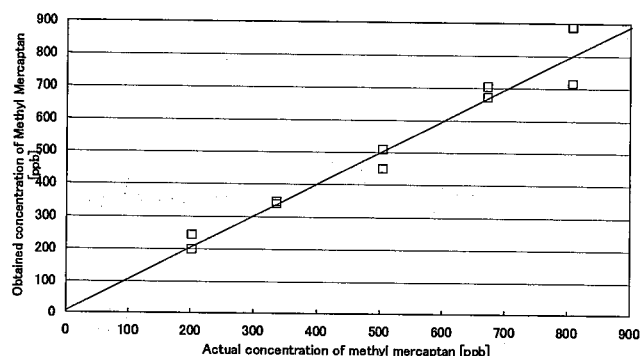


Fig. 2. Relationship between actual concentration and obtained concentration: CH₃SH in binary mixture of CH₃SH and H₂S