proceedings

MDPI

Extended Abstract

Comparative Analysis between Blood Test and Breath Analysis Using Sensors Array for Diabetic Patients †

Hyung-Gi Byun [1,*], Joon-Boo Yu [1], Chong-Yun Kang [2], Byoung Kuk Jang [3] and Hae-Ryong Lee [4]

[1] Division of Electronics, Information & Communication Engineering, Kangwon National University, Kangwon-Do 25913, Korea; jyacht@naver.com
[2] Center for Electronic Materials, KIST, Seoul 02792, Korea; cykang@kist.re.kr
[3] Department of Internal Medicine, Keimyung University Dongsan Medical Center, Daegu 42602, Korea; jangha106@dsmc.or.kr
[4] SW Contents Lab. ETRI, Daejeon 34129, Korea; hrlee@etri.re.kr
* Correspondence: byun7414@gmail.com; Tel.: +82-33-570-6401
† Presented at the 8th GOSPEL Workshop. Gas Sensors Based on Semiconducting Metal Oxides: Basic Understanding & Application Fields, Ferrara, Italy, 20–21 June 2019.

Published: 19 June 2019

Acetone was one of the volatile organic compounds present in respiration, and acetone contained in the exhalation of diabetic patients was found to be a combustion metabolite of body fat. Degradation of acetyl-CoA due to the metabolism of fatty acids in diabetic patients increase the concentration of acetone in the blood. Acetone in the blood is excreted as urine or breath. It has been studied that acetone released from breathing is 0.3 to 0.9 ppm for healthy people and 1.8 ppm or more for diabetic patients. Therefore, a variety of studies have been conducted to monitor diabetes by measuring the acetone gas released from breathing. Methods for measuring the amount of acetone in the exhalation using a GC-MS, an electrochemical sensor, and a method using an array of gas sensors based on metal oxide types were studied.

In this paper, we have been developed an E-Nose system using a metal oxide sensors array and measured the expiration of the normal and diabetic groups to distinguish diabetic patients from normal subjects. And blood samples from those peoples were analyzed to compare the exhaled breath test results using an E-Nose system.

The E-nose system is composed of sensor array, data acquisition and processing, and clustering part. The sensor array shown as Figure 1 was fabricated as one chip by depositing indium and tungsten with electron beam applying glancing angle deposition method at Korea Institute of Science Technology (KIST), Korea. A chamber was used to maintain the stable operating temperature of the sensor array and solid phase microextraction (SPME) fiber was used for the transfer of the measurement gas. Figure 2 is shown full system which has been used for experimental work.

The subjects were divided into controls and diabetes group, and 12 samples for controls and 11 samples for diabetics were selected. The collection and measurement of expiration and blood test were conducted in Dongsan Medical Center after approval of the Institute Review Board (IRB). The Clinical data for this study was summarized at Table 1.

The PCA results for these data are shown in Figure 3. As shown in Figure 3, diabetic patients and controls are distinguished, but some samples were displayed in different areas. In the blood test, Blood Sugar Test (BST), glucose, and HbA1C were given more information for classification. Throughout the primary results for comparative analysis between blood test and breath analysis using a sensors array, we confirm the clustering between controls and diabetics is possible, but we need more specific blood test information to confirm accuracy of breath analysis.

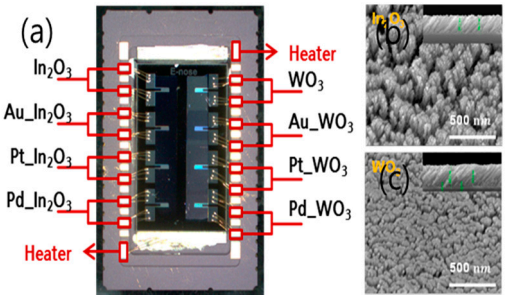

Figure 1. Sensor Array fabricated by KIST.

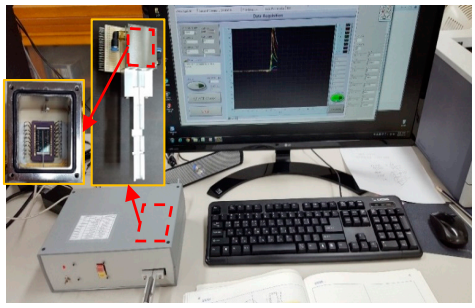

Figure 2. Measurement system using experimental works.

Table 1. Clinical data for the participants in study.

	PLT (×10³/uL)	Glucose (mg/dL)	BST (mg/dL)	T.Bilirubin (mg/dL)	ALP (U/L)	AST (U/L)	ALT (U/L)	HbA1C (%)
Standard Values	130–400	<100	<100	0.3–1.0	66–220	0–35	0–35	<6
Average of Control	261	101	102	0.8264	61.7	22.44	20.84	5.232
Average of Diabetes	273	138	132	0.6984	76.8	23.44	21.18	6.452

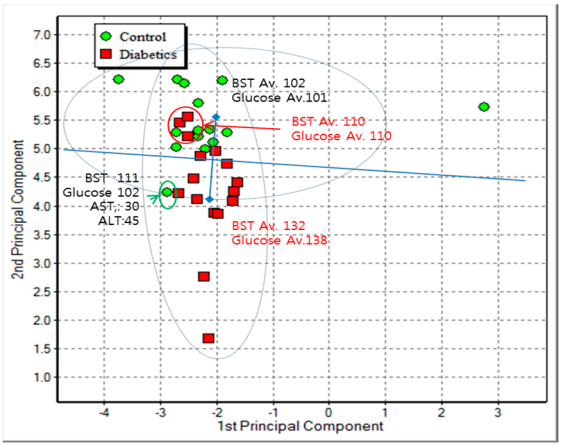

Figure 3. PCA result between diabetics and controls using breath analysis.

Funding: This research was supported by the Institute for Institute of Information & Communications Technology Planning & Evaluation (IITP) grant funded by Korea.

Conflicts of Interest: The authors declare no conflict of interest.