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機関番号：32657

研究種目：基盤研究(C) (一般)

研究期間：2016～2018

課題番号：16K06391

研究課題名(和文)有機系浮遊物質用リアルタイム計測システムの開発

研究課題名(英文)Development of Real-Time Monitoring System for Organic Airborne Particles

研究代表者

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交付決定額(研究期間全体)：(直接経費) 1,900,000円

研究成果の概要(和文)：空気中に浮遊するカビの胞子、排気ガス中に含まれるPM2.5等の微粒子、ハウスダストなどは、様々な病気の原因となる。本研究は、加熱された金属酸化物薄膜表面で、上記の有機系微粒子が接触燃焼することに伴い、薄膜の電気伝導が変化するという新規な検出原理を利用するものであり、上記の有機系浮遊微粒子をリアルタイムで検出するセンサのプロトタイプを開発し、開発したセンサによる検出実験を行った。その結果、ディーゼルエンジンから排出された微粒子およびハウスダストに対して特異な応答パターンが得られ、これらのデータから、花粉やカビの胞子との識別が可能であることが明らかになった。

研究成果の学術的意義や社会的意義

本センサの開発により、PM2.5やハウスダスト、花粉等がリアルタイムで検出可能になり、その種類の識別も可能であることが立証された。本センサの製作には、MEMS(Micro Electro Mechanical Systems;微小電気機械システム)技術および薄膜技術を用いており、小型・軽量であるばかりでなく、大量生産が可能で、電力消費が少ないため、安価で携帯可能なセンサとなりえる。このため、広範な普及が期待される。本センサシステムの開発により、直接目に見えないが有害な各種の有機系浮遊微粒子を検出・表示できるため、これらに対する対策の促進につながると考えられる。

研究成果の概要(英文)：We have developed MEMS-based conductometric sensors for detection of organic airborne particles such as PM2.5 and house dust which may cause a variety of diseases. A sensor was fabricated by using thin film technology, IC fabrication process and micromachining technique. The electric resistance of the sensor steeply decreased and then recovered to the initial value. A small increase appeared before or after the resistance decrease when a piece of PM2.5 and house dust adhered to the surface of the sensing film and burnt on it. The magnitude of the resistance decrease and the recovery time depended on the size of the organic airborne particles. In addition, a small increase of the resistance before or after the large decrease offered some information about the constituents of the particle. Thus it is possible to identify the species of the particle by the sensors. The developed sensors can be used for an inexpensive real-time monitoring system of various organic airborne particles.

研究分野：センサ工学

キーワード：環境計測センサ 有機系浮遊物質 MEMSデバイス PM2.5 ハウスダスト 花粉

MEMS (Micro Electro Mechanical Systems) is a technology that integrates microelectronics and mechanical systems. It is used in various applications such as sensors, actuators, and microfluidics. The main components of MEMS are the substrate, the sensing element, and the micro heater.

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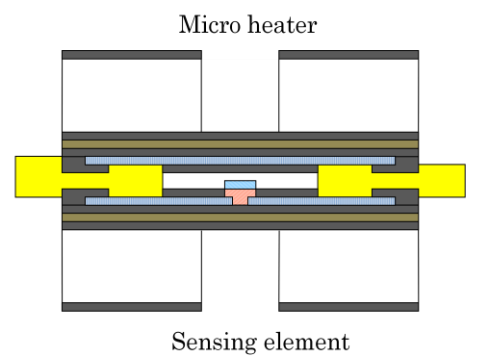
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Legend for the diagram:

- Si substrate
- SiO₂
- Si₃N₄
- Cr / Pt+W / Cr
- Fe₂O₃+TiO₂+MgO
- SnO₂+V₂O₅
- Au wire

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(2) MEMS sensor

210457KS

(DPM) PMW

2 AM DPM

MS

DPM

MS

MS

MS

DPM

Z8Su

MS

SO₂

Gc48Su

n gZb

MS

MS

Mf MS

3 AM

MS

MS

MS

Z94b

MS

NO₂ MS

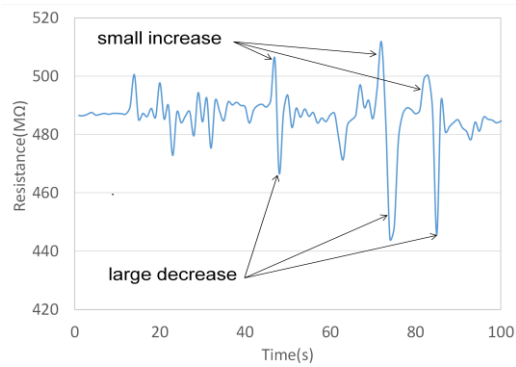
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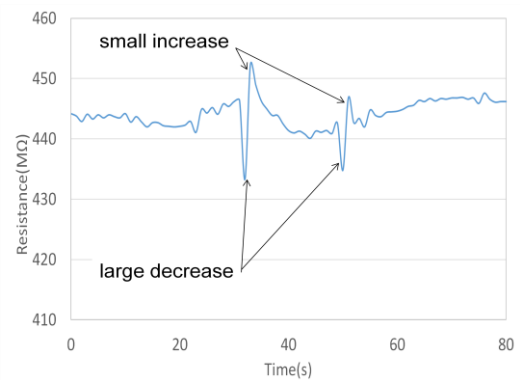
MS

DPM

MS



W 2 DPM



W 3

(3) ZnO

ZnO

MS

MS

MS

MS

(W) MS

MS

MS

MS

MS

W 4 MS

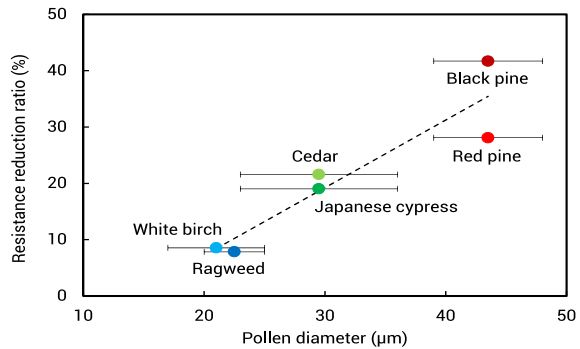
MS

MS

MS

1A

S



W 4

MS

(4) MS

(mbed LPC1768)

ZMS

MS

MS

MS

MS

MS

(MS) MS

MS

S

3 > MS

MS

7 MS

MS

Naomichi Jimbo, Ren Horiuchi, Tomiharu Yamaguchi, Kazuhiro Hara, MEMS-Based Conductometric Sensors for Organic Airborne Particles, 17th International Meeting on Chemical Sensors, 11, -, 2018, pp.570-571, DOI:10.5162/IMCS2018/P1MM.4

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