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HU-ACE NEWS LETTER

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Activities of the Core

Feb. 5,12,19, 2022	Professor Ichikawa and Associate Professor Miyaoka held an online extension course "Carbon Neutral for Solving Global Warming Problems".
Feb. 16, 2022	The 99th Hiroshima University Biomass Evening Seminar (co-organized)
Feb. 16, 2022	The 69th HU-ACE Steering Committee Meeting.
Feb. 22, 2022	Society for the Hydrogen energy and Next-generation energy Utilization ～ Seminar 2020 vol.2(co-organized)

We held a plenary session for the entire center.

On January 26, 2022, the plenary session of HU-ACE was held. The purpose of this meeting was to confirm the status of operations, exchange opinions among members of the base, and share the direction of our activities. At the same time, awards were given for the publication of treatises. At this center, three categories of commendations are given for papers registered in 2021. This time, Professor Nishida, Professor Ichikawa, and Associate professor Ogata were awarded in the number of papers category, and Professor Yorino, Associate professor Ogata and Assistant Professor Yamasaki were awarded in the increase in number of papers category, and Professor Yorino, Associate professor Kindaichi and Assistant Professor Yamasaki were awarded in the thesis increase rate category. For reference, the graph of the number of papers from 2012 to 2021 is attached below. After establishment of this center in 2017, number of publication increase is clear.

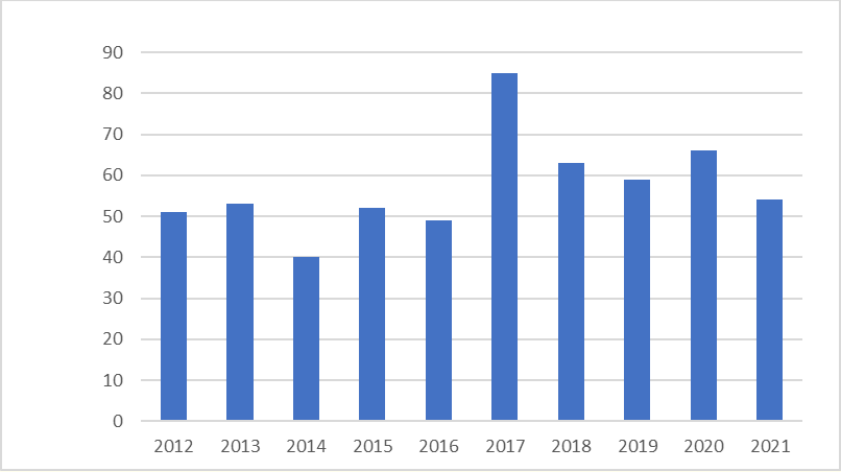

Figure: Changes in the number of treatises over time

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HU-ACE NEWS LETTER Advanced Core for Energetics, Hiroshima University Vol. 62

Research Topics

No. 29

Development of gas sensor using carbon nanotube thin film

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Research fields: Micro-Nano Thermal Engineering

Keywords: Thin Film, Sensor

Abstract

Background

As a matter of course, gas masks are used at workplaces where organic solvents are used, and these masks have filters that absorb the gases and prevent workers from inhaling them. The life of the filter is called "breakthrough," after which the permeability of toxic gases increases rapidly. The problem is that there is no data for the life of filters for a wide variety of organic solvents, and there are only guidelines based on certain standard solvents. The degree of respiration depends on the workload and the individual. Therefore, employers are claimed to replace earlier for safety reasons, and workers might work with an anxiety. We hope to solve these problems by developing a disposable sensor that can be integrated into the mask.

Methods

There are various types of gas sensor systems, but the semiconductor type seems to have the best performance. However, these sensors need to be heated to a certain degree in order to increase reactivity with gases, and power consumption is a problem. Carbon nanotubes are chemically stable materials, and it was reported that they can respond to gases even at room temperature[1]. The principle of this phenomenon was unknown for a while, but our group clarified it[2]. The principle of detection is that chemically stable carbon nanotubes cannot chemisorb only highly reactive gases, but respond to a slight increase in electrical resistance caused by physically adsorbed gas molecules at the contact points between carbon nanotubes connected like a pasta on a dish. Using this principle, we measured the response to a Class II organic solvent.

Results

In our previous studies, adsorption on carbon nanotube thin films could be represented by a one-layer physisorption model, with a few exceptions. The model follows the Langmuir adsorption isotherm, but we do not explain the mechanism here because of space limitation. However, while measuring the response of several organic solvents, we found that some of them did not follow the Langmuir adsorption isotherm. After sorting them out, we found that they were non-polar solvents. As shown in the figure, they exhibit a two-step response. We consider that this is Type 6 of the six IUPAC classifications. The reason why it is Type 6 and not Type 4 is that Type 4 is considered to be when the interaction with the surface is strong or when there is a mesoporous on the surface, both of which do not match this condition. We are currently in the process of writing a paper on this subject, so I will leave the details for another opportunity.

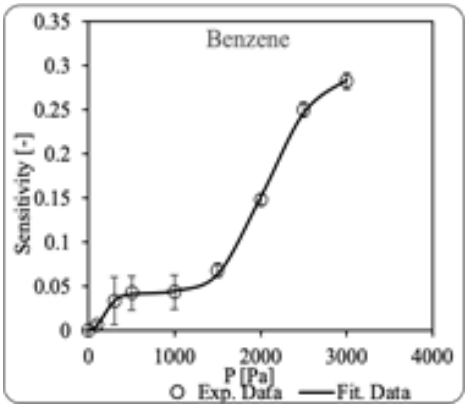

Figure Response of carbon nanotube film to benzene.

References

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[3] T. Kokabu, K, Takashima, S. Inoue, T. Y. Matsumura, T. Yamamoto, J. Appl. Phys. 122, 015308 (2017).