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2020.07.27

## **Professor Young Min Song's collaborative research team develops color sensors using viruses that change color when harmful substances are touched**

- As can be seen in the current coronavirus pandemic, the technology to quickly detect and accurately identify harmful substances such as chemicals and environmental hormones is becoming increasingly important.
- GIST (Gwangju Institute of Science and Technology, President Kiseon Kim) School of Electrical Engineering and Computer Science Professor Young Min Song and Pusan National University Jin-Woo Oh's joint research team developed an ultra-fast virus-based color sensor\* for detecting harmful substances.

\* color sensor (colorimetric sensor): A sensor that detects chemical elements or compounds through color changes based on color reagents and functional color filters.

- Color sensors that can detect very small harmful particles and can be observed intuitively can detect harmful substances by simply changing color. In addition, it can be easily used in real life in conjunction with a portable smart device, and it is expected to be a next-generation harmful environment detection sensor because it does not require separate energy for operation.
- To increase the practicality of color sensors, the research team applied a thin coating of M13 bacteriophage virus\* on a large area (sub-centimeter) to achieve a very fast response rate of 110 ms, which is 2.5 times faster than that of conventional complex globules.

\* M13 bacteriophage virus: It is harmless to the human body and is approved by the US Food and Drug Administration (FDA), which uses E. coli as a host to increase the number of individual genes by cloning. It has the characteristic of expanding by the penetration of harmful substances and widening the gap between nano-structures, and it is possible to express various chemical functional groups on the surface protein.

- In particular, genetic modification of the surface of the virus controlled the responsiveness of the virus to various harmful substances, such as various volatile organic compounds and environmental hormones, and succeeded in distinguishing similar types of harmful substances at very low concentrations of tens of ppb\*.

\* parts per billion: a concentration of one-billionth

- This technology has had the advantage of easily observing harmful substances through color change, but it has been very disadvantageous in terms of detection speed and sensitivity because it has to form a complex structure to implement colorization.
  - The research team designed a resonant amplifying substrate and applied it as a sensor platform so that it could realize a clear color even in a very thin virus layer (60 nm) without a complicated structure. In addition, through the design of the resonant condition of the color development structure, a sensor that is not normally visible was produced, and the pattern was revealed only in a specific environment to enable intuitive observation of harmful substances.
- GIST Professor Young Min Song said, "The application of nanometer-level fiber-type virus induced the coupling between harmful substances and color sensors, and the optical design made it possible to intuitively detect harmful substances. It is expected that in-depth genetic manipulation and optimization of the platform for color sensors will enable intuitive and rapid detection of various harmful substances."
- This research was supported by the Future Materials Discovery Project promoted by the Ministry of Science and ICT and the National Research Foundation of Korea and by the basic laboratory support project of GIST GRI and was published on July 21, 2020, in the *Advanced Science* (IF: 15.840).

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