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Professor Gun Young Jung's research team develops a next-generation vertically stacked optical sensor capable of distinguishing the color of light without an optical filter

- GIST (Gwangju Institute of Science and Technology, President Kiseon Kim) School of Materials Science and Engineering Professor Gun Young Jung's research team developed a single optical sensor capable of analyzing the wavelength of light without an optical filter by vertically stacking organic-inorganic hybrid perovskite* thin films.

* organic-inorganic hybrid perovskite: A semiconductor thin film formed while having a perovskite crystal structure when certain organic substances and metal cations are mixed. The absorption rate of visible light is high, and the efficiency of forming a photoelectron-hole pair from the absorbed light is high.

- Perovskite thin-film stacked optical sensors are expected to have significantly improved sensitivity and improved resolution than conventional optical sensors and can be widely used in various industrial fields such as medical, optical communication, smart devices, and autonomous vehicles.
- Photoelectric effect-based optical sensors that convert light into electrical signals are typically widely used in solar cell technology. Optical sensors are essential components for utilizing renewable energy and for smartphones, the Internet of Things (IoT), and optical communication. In particular, compared to other diagnostic methods in the medical field, diagnosis and constant monitoring can be

performed more easily, so technology development using optical sensors is actively progressing.

- The currently commercialized silicon-based optical sensor must be equipped with an optical filter capable of transmitting only light of a specific wavelength to distinguish the color (or wavelength) of light. However, in addition to the high cost required in the process of combining the optical filter with the optical sensor, the amount of light is reduced when the light passes through the filter, resulting in a problem that causes the sensitivity of the optical sensor to deteriorate.
- For this research, a new concept device that can distinguish the color (or wavelength) of light with only one vertically stacked device without an optical filter was implemented. Different spectrums of light were extracted according to the voltage applied to the optical sensor, and the wavelength of light was accurately distinguished without an optical filter.
- The research team also succeeded in accurately extracting the color index (R, G, B) of natural light through the corresponding optical sensor. With this system, colors can be distinguished with more than twice the resolution of an image sensor that requires three or more filters.
- Professor Gun Young Jung said, "The study not only presented a solution to overcome the problems derived from existing optical filters, but it also presented a new paradigm for the use of perovskite materials. In the future, the scope of research will be expanded to areas such as high-resolution image sensors, optical-based biosensors, and optical communication systems."
- The research was led by GIST Professor Gun Young Jung and GIST Research Institute for Solar and Sustainable Dr. Sooncheol Kwon as co-corresponding authors with support from the Basic Science Research Program and the Young Researchers Program, ICT & Future Planning of the National Research Foundation of Korea funded by the Ministry Science and ICT, and by a GIST Research Institute (GRI) RISE grant and was published on September 11, 2020, in *Laser & Photonics Reviews*, a renowned international journal in the field of optics.

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