Gwangju Institute of Science and Technology
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Section of Public Relations	Hyo Jung Kim Section Chief (+82) 62-715-2061	Nayeong Lee Senior Administrator (+82) 62-715-2062
Contact Person for this Article	Professor Young Min Song School of Electrical Engineering and Computer Science (+82) 62-715-2655	
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Professor Young Min Song's research team identifies the optical phenomena of semiconductor "nanowire bundles" applicable to artificial retinas

□ GIST (Gwangju Institute of Science and Technology, President Kiseon Kim) School of Electrical Engineering and Computer Science Professor Young Min Song's research team investigated the optical phenomena of high-density, irregularly distributed semiconductor nanowire bundles * and also proposed a method for large-scale fabrication of optimal nanowire bundle structures.

* nanowire bundle: a bundle made of several nanowires that are one-thousandth the thickness of hair

◦ The vertical nanowire array * based on semiconductor materials has recently attracted attention as a key material for next-generation electronic devices based on excellent mechanical, electrical, and optical properties. However, most nanowire arrays have very small structures ranging from tens to hundreds of nanometers (one-billionth of a meter), making them costly and difficult to produce on a large scale because they are built through an electron beam lithography ** process.

* nanowire array: regular arrangement of very thin columns with heights of a few micrometers and a diameter of tens to hundreds of nanometers, also called a nano-forest

** electron beam lithography: a technology that accurately depicts fine LSI patterns of around 1 μm or less in line width by a thinly clamped electron beam

- In addition, semiconductor nanowire arrays have been mainly studied only for application to high-efficiency solar cells, image sensors, and laser devices based on the spectral phenomenon observed in the macro world.

□ The research team identified microscopic optical phenomena occurring within the bundle of high-density/irregular semiconductor nanowires that have not been noticed through 3D wave equation-based analysis methods and observed them experimentally.

- To overcome the limitations of the existing research, the team has grown a high-density, very thin gallium arsenide (GaAs) nanowire bundle on the front surface of the silicon wafer without a lithography process. In addition, dense nanowire bundles were separated from silicon wafers (thin plates that become materials of semi-conductors) by coating them with transparent polymer PDMS materials and then scraping them off with razor blades.

- The proposed method through this study can be grown on inexpensive silicon wafers, and after separation of the grown nanowire bundles, the wafers can be recycled again, which is very economical.

  * aspect ratio: refers to the ratio of the height to the horizontal diameter of the nanowire, and the larger the aspect ratio, the thinner and longer the nanowire

□ Professor Young Min Song said, "The most important significance of this study was that it does not require an electron beam lithography process, which is a limitation of the existing vertical semiconductor nanowire array, and that it identified microscopic optical phenomena within the bundle of nanowires that were not previously illuminated. In particular, the selective wavelength absorption characteristics of the nanowire bundle can be used as a physically non-replicable security hardware, and is expected to be used as an artificial retina material having a much higher resolution than the human eye."

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