Spherical artificial eye with 3D retina

Departments - 1 Last Look

Nanowire light sensors improve bionic and potentially human vision.

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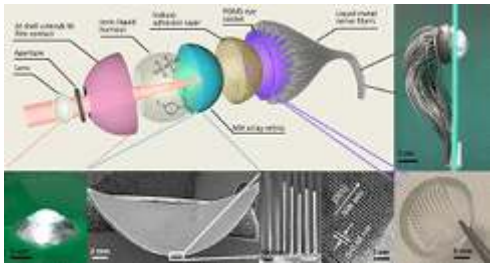

Structure of the EC-Eye created by an international team led by HKUST scientists.
PHOTO COURTESY OF HKUST

A 3D artificial eye exceeds the capabilities of existing bionic eyes and even some human ones, potentially bringing vision to humanoid robots and new hope to people with visual impairments.

Scientists have spent decades trying to replicate the structure and clarity of a biological eye, but existing prosthetic eyes – usually spectacles attached to external cables – provide poor resolution with 2D flat image sensors. Developed by an international team led by scientists at the **Hong Kong University of Science and Technology (HKUST)**, the Electrochemical Eye (EC-Eye) replicates the structure of a natural eye and may eventually offer sharper vision than a human eye with extra functions such as infrared radiation detection in darkness.

The key feature is a 3D artificial retina – an array of nanowire light sensors which mimic the photoreceptors in human retinas – developed by Professor Fan Zhiyong and Dr. Gu Leilei from the Department of Electronic and Computer Engineering at HKUST. The team connected the nanowire light sensors to a

reflect what the eye sees onto a computer screen.

In the future, these nanowire light sensors could be directly connected to visually impaired patients' nerves. Human eyes use bundles of optic nerve fibers routed through the retina via a pore to reach the brain, which creates a blind spot in human vision. Light sensors, scattered across the manmade retina, could each feed signals through their own liquid-metal wire, eliminating the blind spot, as they don't have to route through a single location.

Nanowires have higher density than photoreceptors in the human retina, so the artificial retina can receive more data and potentially attain a higher image resolution than the human retina if contacts to individual nanowires are made in the future. With different materials used to boost the sensors' sensitivity and spectral range, the artificial eye may achieve other functions such as night vision.

"Regardless of image resolution, angle of views, or user-friendliness, current bionic eyes are still no match for their natural human counterpart. A new technology to address these problems is in urgent need, and this gave me the strong motivation to start this unconventional project," Fan says.

The team collaborated with the **University of California, Berkeley**. The working principle of the artificial eye involves an electrochemical process adopted from a type of solar cell. Each photo sensor on the artificial retina can serve as a nanoscale solar cell. With further modification, the EC-Eye can be a self-powered image sensor, eliminating external power sources or circuitry when used for ocular prosthesis.

"In the next step, we plan to further improve the performance, stability, and biocompatibility of our device. For prosthesis application, we look forward to collaborating with medical research experts on optometry and ocular prosthesis," Fan adds.

Hong Kong University of Science and Technology (HKUST)
http://www.ust.hk

University of California, Berkeley
https://www.berkeley.edu

See the EC-eye in action: https://youtu.be/8IV98kWspks

research additive/3D components

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