# Novel bio-syncretic phototransistor developed based on living cells for visual perception

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Integration of living visual elements into visual prosthesis design can inherit the merits of biological visual systems and enhance its overall biocompatibility. However, the current studies of photodetection using biological elements have the disadvantages of slow response and low imaging capability, and thus cannot meet the demand of visual perception.

Optogenetics sheds light on developing bio-syncretic visual prostheses.

In a study published online in *Biosensors and Bioelectronics*, the researchers from Shenyang Institute of Automation of the Chinese Academy of Sciences (SIACAS), Tsinghua University, and University of Hong Kong, developed a novel bio-syncretic phototransistor with optogenetically engineered cells and a graphene-based structure for visual perception.

Optogenetically engineered cells are the core element of the bio-syncretic phototransistor. The researchers expressed photosensitive proteins, Channelrhodopsin-2 (ChR2) to be specific, on cell HEK293 and got these cells. Control experiments showed that the use of photosensitive proteins can largely enhance the photoelectric response and broaden the dynamic response range of the phototransistor.

Besides, they used monolayer grapheme film to construct a non-destructive and high-throughput interface between the optogenetically engineered cells and a transistor-structured mechatronics system,

realizing effective detection of the weak photoresponsive bioelectrical signals of the cells.

Imaging experiments demonstrated that the phototransistor owns excellent photoresponsive properties in comparison with the bioengineered photodetectors reported in the previous literatures. Owing to the ultra-fast dynamics of the ChR2 variant E123A expressed on the cells, such phototransistor has a distinct advantage with respect to response time and owns optical and biological gating with a significant large on/off ratio of 197.5 and high responsivity of 1.37 mA W-1. The time-saving, easy handling, and non-invasiveness phototransistor enables the direct use of biological components for visual perception.

As the most important sensory system for human beings, visual systems acquire and process up to 80% of external information. For individuals suffering from blindness, visual prostheses are critical to regain functional vision. It is possible to imagine that one day biological cells are transplanted into humans as visual prostheses.

**More information:** Jia Yang et al. A bio-syncretic phototransistor based on optogenetically engineered living cells, *Biosensors and Bioelectronics* (2021). DOI: 10.1016/j.bios.2021.113050

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