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Professor Jongho Lee and Professor Tae Kim's joint research team develops a wearable optogenetic device that controls the brain with light

▫ GIST (Gwangju Institute of Science and Technology, President Kiseon Kim) School of Mechanical Engineering Professor Jongho Lee and Department of Biomedical Science and Engineering Professor Tae Kim's joint research team developed a wearable optogenetics* device that controls the brain with light by driving a brain-insertable LED device with a human-insertable solar cell.

* optogenetics: The latest brain science methodology to control neuronal activity at a time resolution of 1000th of a second using light.

◦ This research achievement is a step closer to clinical use of brain disease treatment through optogenetics by suggesting solutions for sustainable light source development, which is one of the major difficulties in the development of optogenetic therapy.

▫ Optogenetics is a precise nerve control method that has emerged rapidly in the field of brain science in the last 15 years. It is a breakthrough brain science

technology that can turn neurons on and off depending on the presence or absence of light by expressing photoreactive heterogeneous proteins in neurons, that is, neurons, which are the main actors for brain activity.

- However, the current method of applying optogenetics is that a light source that operates wirelessly has also been developed, but only on a platform where a magnetic field is operated to supply power. Due to the limitations of operation, it is necessary to develop a light source that is sustainable *in vivo* with no external connections.

- The research team designed and manufactured a near-infrared-based wireless power generation device capable of generating sufficient power while inserted under the skin. For this, a small solar cell device with increased flexibility was first implanted into the subcutaneous tissue as a power supply, and a system capable of generating power was implemented using near infrared light (NIR), which has the highest skin penetration efficiency. The light emitting part inserted into the brain generated flashing light at a specific frequency, thereby enabling optogenetic brain control.

  - The research team inserted a light-emitting part that generates light into the three-dimensional coordinates of the brain area that makes the mouse's whiskers move back and forth through stereotactic brain surgery. It was verified that the wearable optogenetic device was successfully operated *in vivo* by confirming that the whisker motion was accurately triggered by operating the light source with a remote switch while inducing power generation with near-infrared rays. In particular, the design was modified by repeatedly changing and verifying the device with the animal model so that it works stably in the body, which is an environment having moisture and peristalsis.

- Professor Tae Kim said, "Optogenetics is a methodology with great potential, not only for brain science research through precise brain control, but also for clinical use in the treatment of neuropsychiatric diseases. This research is a fusion study conducted by experts in engineering and brain science, and it is meaningful in that it has shown that innovative solutions can be derived when different disciplines converge."

- The research was led by GIST Professor Jongho Lee and Professor Tae Kim and conducted by Ph.D. students Jinmo Jeong and Jinmo Jeong as co-first authors with support from the National Research Foundation of Korea (NRF), the Basic Science Research Laboratory, and the Engineering Research Center of Excellence Program and was published online on March 4, 2021, in *Biosensors and Bioelectronics*, the most prestigious journal in the field of biotechnology.

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