Nanotube transistor controlled by ATP could improve man-machine communication

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Scientists have built a hybrid bionanoelectronic transistor that can be powered by ATP, or adenosine triphosphate, the energy currency in living cells. The researchers, Aleksandr Noy and colleagues from Lawrence Livermore National Lab, claim that the new transistor is the first integrated bioelectronic system, and could provide a way to integrate electronics with the body.

"I hope that this type of technology could be used to construct seamless bioelectronic interfaces to allow better communication between living organisms and machines," Noy said.

The ATP-powered transistor consists of a carbon nanotube stretched between two electrodes. The ends of the nanotube are coated with an insulating polymer layer, and the entire system is then coated in a lipid bi-layer, which is similar to the coating in cell membranes.

When the scientists applied a voltage across the electrodes and poured a solution containing ATP, potassium ions, and sodium ions onto the device, it caused a current to flow through the electrodes. The more ATP used, the stronger the current became.

As the scientists explain, the device works this way due to a protein in the lipid bi-layer that acts as an ion pump when exposed to ATP. During each cycle, the protein pumps three sodium ions in one direction and two potassium ions in the opposite direction, resulting in the net pumping of one charge across the lipid bi-layer to the nanotube. When the ions build

up, they create an electric field around the middle of the nanotube, increasing its conductivity.

In other words, the system works by transforming the nanoscale mechanical energy from the movement of ions into electricity. In this way, the transistor could be used to build electronic devices that can be powered and controlled with biological signals. For example, it could lead to electronics that reside permanently inside the body without requiring batteries or external power supplies, as well as prosthetic devices that can be wired directly into the body's nervous system.

More information: Shih-Chieh J. Huang, et al. "Carbon Nanotube Transistor Controlled by a Biological Ion Pump Gate." *Nano Letters*. Doi:10.1021/nl100499x
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