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According to study lead professor Ken Shepard, this is the world’s first successful effort to isolate a biological process and use it to power an integrated circuit, much like the ones we use in phones and computers.

The researchers developed the system by using an artificially created lipid bilayer membrane containing naturally occurring ion pumps, which are powered by the biological world’s « energy currency molecule, » ATP (adenosine triphosphate). ATP is the coenzyme that transfers chemical energy between living cells. It is an end product of processes such as photosynthesis and cellular respiration, and it powers the mechanical work of living systems such as cell division and muscle contraction.

The scientists connected the lipid membrane to a conventional solid-state complementary metal-oxide-semiconductor (CMOS) integrated circuit, and the ion pumps powered the circuit.

« Ion pumps basically act very similarly to transistors, » Shepard tells Gizmag. « The one we used is the same kind of pump that is used to maintain the resting potential in neurons. The pump produces an actual potential across an artificial lipid membrane. We packaged that with the IC and we used the energy across that membrane due to those pumped ions to power the integrated circuit. »

Using an isolated and artificially created biological component is a different approach to interfacing whole living systems with chips, which was done in the past with varying success.

« We don’t need the whole cell [now], » Shepard says. « We just grab the component of the cell that’s doing what we want. For this project, we isolated the ATPases because they were the proteins that allowed us to extract energy from ATP. »

Shepard says the team is excited about the prospect of extending the range of possibilities in electronics.

« As technology scaling ends, we have to be a little bit more creative and expansive in the way we define an electronic device and the material systems that we use to create electronic devices, » he says. « How do we expand the palette? That’s essentially what this work is about. »

The key challenges now are to try to scale the system down, and to look for ways to manage biological decay.

Challenges aside, the potential for combining biological and electronic processes certainly fires the imagination.

« 100 Intel designers couldn’t design a system that could tell if there’s a skunk in the room or not, and the best synthetic biologists in the world couldn’t build a radio, » quips Shepard. « But if we can just use the piece of the biological process that we want and use its function with solid state electronics, we’ll get that enhanced functional palette of capabilities that don’t exist with chips alone. »

The research was recently published in Nature Communications.

Source: Columbia University

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