Synthetic synapse mimics dynamic memory in human brain

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Researchers from UCLA and Japan have designed a synthetic synapse for use in computing equipment that mimics the function of synapses in the human brain. The silver sulfide, nanoscale synapse, or "atomic switch," demonstrates both short- and long-term memory to a degree not seen before in solid-state devices.

In the brain, synapses are the junction between neurons that enable the transmission of electrical messages from one neuron to another. Emulating this, the silver sulfide synapse is made up of two metal electrodes separated by a nanoscale gap. In their study, the researchers applied a voltage, or "electrical message," to the device at two different intervals — one in which the input pulse was repeated every 20 seconds (lower repetition), the other in which it was repeated every two seconds (higher repetition).

At the lower repetition rate, the synapse achieved a higher conduction state directly after each input, but that state rapidly faded on its own. This mirrors the short-term plasticity (STP) of a human synapse. At the higher repetition rate, however, the synapse achieved a permanent transition to a higher conduction state, successfully mimicking the long-term potentiation (LTP) mechanism of a human synapse.

The STP and LTP activity of the synthetic synapse, the researchers say, conforms to psychological models of human memory — including short- and long-term memory — and can be achieved without the need for external preprogramming or the poorly scalable software currently used

in artificial neural network systems.

The research represents an important advance toward the construction of artificial neural systems that emulate characteristics of human memory and cognition and could have a significant impact on the future design of computer architecture.

More information: The research was recently published online in the journal *Nature Materials* and is available at bit.ly/pDoXJB

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