An organic transistor paves the way for new generations of neuro-inspired computers

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For the first time, French researchers at CNRS and CEA have developed a transistor that can mimic the main functionalities of a synapse.

This organic transistor, based on pentacene and gold nanoparticles and known as a NOMFET (Nanoparticle Organic Memory Field-Effect Transistor), has opened the way to new generations of neuro-inspired computers, capable of responding in a manner similar to the nervous system. The study is published in the 22 January 2010 issue of the journal *Advanced Functional Materials*.

In the development of new information processing strategies, one approach consists in mimicking the way biological systems such as neuron networks operate to produce electronic circuits with new features. In the nervous system, a synapse is the junction between two neurons, enabling the transmission of electric messages from one neuron to another and the adaptation of the message as a function of the nature of the incoming signal (plasticity). For example, if the synapse receives very closely packed pulses of incoming signals, it will transmit a more intense action potential. Conversely, if the pulses are spaced farther apart, the action potential will be weaker.

It is this plasticity that the researchers have succeeding in mimicking with the NOMFET.

A transistor, the basic building block of an electronic circuit, can be used as a simple switch - it can then transmit, or not, a signal - or instead offer

numerous functionalities (amplification, modulation, encoding, etc.).

The innovation of the NOMFET resides in the original combination of an organic transistor and gold nanoparticles. These encapsulated nanoparticles, fixed in the channel of the transistor and coated with pentacene, have a memory effect that allows them to mimic the way a synapse works during the transmission of action potentials between two neurons. This property therefore makes the electronic component capable of evolving as a function of the system in which it is placed. Its performance is comparable to the seven CMOS transistors (at least) that have been needed until now to mimic this plasticity.

The devices produced have been optimized to nanometric sizes in order to be able to integrate them on a large scale. Neuro-inspired computers produced using this technology are capable of functions comparable to those of the human brain.

Unlike silicon computers, widely used in high performance computing, neuro-inspired computers can resolve much more complex problems, such as visual recognition.

More information: An Organic Nanoparticle Transistor Behaving as a Biological Spiking Synapse. Fabien Alibart, Stéphane Pleutin, David Guérin, Christophe Novembre, Stéphane Lenfant, Kamal Lmimouni, Christian Gamrat and Dominique Vuillaume. *Advanced Functional Materials*. 22 January 2010

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