

# Devices

CNRS – IEMN & CEA – LIST:

## Nanoparticle organic memory field-effect transistor

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Nanofloating memory devices possibly mimicking nature



There are an increasing number of publications related to organic field effect transistors (FET) where metal nanoparticles are incorporated into the FET channel [1-3]. These devices structures exhibit memory effects and can also be called nanofloating memory devices. Recently, this device concept hit the headlines thanks to a joint work of two French teams within the National Science Agency (CNRS) and the Atomic Energy Commission (CEA). The device reported is basically a pentacene based TFT where a layer of gold nanoparticles is attached to the dielectric surface using surface chemistry techniques. While studying the charge transport across these devices structures the authors found out that in pulsed mode, the charge flow is similar to the transport of chemical neurotransmitters through a synaptic connection in the brain. The authors claim that the device can mimic a biological synapse.

The device concept has been around and tentatively explored as a memory. The novelty resides on the idea that under pulsed mode, the device can mimic a biological synapse. The interest for the scientific community is at the moment more at a fundamental level. Understanding, the basic physics of the devices may lead to novel device concepts and to a niche of applications away providing new functions.

Resistive switching effects are a remarkably universal phenomenon in composite systems, in which metal nano-particles are embedded in an insulating or semiconducting host. In spite of the numerous studies the memory mechanism is still elusive. The merit of the French team lies on calling the attention of the scientific community for these device structures and their possible applications

[1] "An organic nanoparticle transistor behaving as a biological spiking synapse" ; F. Alibart, S. Pleutin, D. Guerin, C. Novembre, S. Lenfant, K. Lmimouni, C. Gamrat, D. Vuillaume : [Advanced Functional Materials](#) 20, 330 (2010).

[2] "Electrical bistability in pentacene film-based transistor embedding gold nanoparticles" ; C.W. Tseng, Y.T. Tao : [Journal of the American Chemical Society](#) 131, 12441 (2009).

[3] "Nonvolatile nano-floating gate memory devices based on pentacene semiconductors and organic tunneling insulator layers" ; S.J. Kim, Y.S. Park, S.H. Lyu, J.S. Lee : [Applied Physics Letters](#) 96, 033302 (2010).