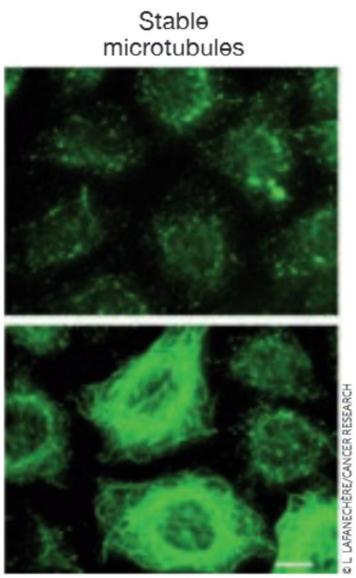
02 Treatment of a model cancer cell line (Hela) with LIMK inhibitor Pyr-1 increases stable microtubules content (green) without affecting dynamic microtubules (red).

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Physics

# Bio-Inspired Computing Memory


**BY** BRETT KRAABEL

**→How long does it take your brain to recognize a face? Not long.** Yet for computers, this is an extremely challenging task. Now, researcher Manuel Bibes[1] and his colleagues at CNRS, Thales, and the University of Cambridge have mimicked nature by building electronic components called memristors that are inspired by the brain's computational circuitry.[2]

In our brain, neurons act as computing units, each of which is connected to a thousand other neurons by synapses. But synapses also serve as memory, which contrasts starkly with the design of computers, where memory is a separate entity from the computing unit. A much more glaring difference is that neurons communicate through voltage pulses rather than direct current (DC) voltages. The result is that the brain is far more powerful and energy-efficient than any man-made computer.

Memristors mimic synapses in that they act as wires whose electrical resistance depends on the previous voltage pulses sent through them, giving them memory. The first memristor, produced in 2008, was based on the diffusion of ions through a thin film; a phenomenon poorly understood and difficult to control. To overcome this difficulty, Bibes and his collaborators have built memristors based on ultrathin ferroelectric films sandwiched between metal electrodes.

Ferroelectric films provide an answer because they retain an electric polarization after being exposed to an electric field (i.e., a voltage). "This lets them store information, much like ferromagnets in magnetic hard disks," explains Bibes. When placed between metal electrodes, the polarization of the ferroelectric film determines the electrical resistance of the memristor. In this way, the resistance of the device depends on its voltage history, permitting memory storage.

In contrast to conventional memory circuits, which store only two bits, the resistance of ferroelectric memristors can be finely tuned, allowing them to contain much more information. This is possible because the film becomes polarized in nm-sized chunks, called domains. By varying the voltage applied across the film, the density of polarized domains can be precisely controlled, allowing the resistance to be tuned between a minimum value and a maximum value 300 times greater.

Another advantage of ferroelectrics is that they have been studied for decades, so the mechanisms of domain formation and interaction are well understood. The team now plans to use this knowledge to build a "neural network" with 10 electronic neurons and 100 memristor synapses.

01. Unité mixte de physique CNRS / Thales.
02. A. Chanthbouala et al., "A ferroelectric memristor," *Nature Materials*, 2012. 11: 860-4.

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## And more news...

# *Islamic Art*

**→ Using a non-invasive and mobile Raman spectroscopy technique on four ancient lamps, researchers[1] have revealed the secrets of Mamluk Sultanate enamellers (Egypt and Syria: 1250-1517).[2] Lapis lazuli or cobalt were used for blue, and mixed with Naples yellow to produce green, while tin oxide precipitates or calcium phosphate were used for white. Comparison with replicas by 19th century master glassmakers unambiguously shows that very different pigments were used in that later period. This study therefore provides tools to identify recently-restored sections or copies from originals.**

01. Laboratoire de dynamique, interactions et réactivité (CNRS / UPMC).
02. P. Colomban et al., *J. Raman Spectrosc.*, 2012. 43: 1975–84.

→ The Tuquztimur lamp, one of the Mamluk objects analyzed by Raman spectroscopy.

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# Staying Alert

**→ Blue light proved as effective as coffee to keep drivers alert during long journeys at night.[1]** Although the positive effect of blue light on nighttime alertness was known since 2005 for simple tasks, it had never been tested on highly-complex tasks like driving. The study, conducted by teams from France[2] and Sweden, could lead to the development of electronic anti-sleep systems built into vehicles.

01. J. Taillard et al., *PLoS ONE*, 2012. 7(10): e46750.
02. Sommeil, attention et neuropsychiatrie (CNRS).