Organic flash memory developed

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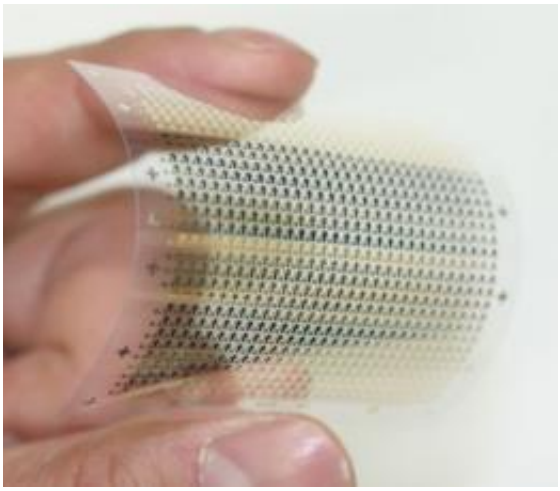

The polyethylene naphthalate resin sheet with a memory array.

(PhysOrg.com) -- Researchers at the University of Tokyo have developed a non-volatile memory that has the same basic structure as a flash memory but is made from cheap, flexible, organic materials.

Flash memory devices store data electrically in silicon transistors. The information can be written and read quickly and is retained in memory even when power is removed. This makes flash memory useful for devices such as cameras, USB drives, and MP3 players. If a flexible flash memory can be developed it could find application in large-area devices such as large area sensors, displays, or actuators with flash memory built-in.

The organic flash memory was developed by a team of scientists led by Professor Takeo Someya, of the Department of Engineering and Information Systems at the University of Tokyo. The device uses an array of 26 x 26 memory cells on a plastic polyethylene naphthalate (PEN) resin sheet substrate that is flexible enough to be curved to a radius of only 6 mm without causing electrical or mechanical problems.

The device is called an organic flash memory device because it has the same kind of floating-gate transistors as those used for silicon-based flash memories. A floating gate is a component of the transistor that is fully enclosed by a thin insulating material called a gate dielectric, which isolates it electrically and allows it to retain its charge for years (in silicon devices). If a large voltage is applied an electronic charge can be brought on to the floating gate and it remains there until the charge is erased when a voltage of opposite polarity is applied.

Professor Someya said the challenge for an organic memory device is finding a suitable insulating material to electrically isolate the floating gate in which the charges are stored. The layer has to be thin enough to allow charge to be transferred to the floating gate but must not melt during assembly. The insulating layer prevents the electrons leaking away and consequent degradation of the data.

The insulating film was made using a two nanometer thick self-assembled monolayer (SAM) and a four nanometer layer of aluminum oxide formed by oxidizing the surface of the aluminum floating gate.

The erasing voltage of the memory is around 6V, while the reading voltage is only 1 V, and these voltages are considerably lower than those of organic memories developed previously. Data can be written to and erased from the memory over one thousand times, which is much less than the 100,000 times for silicon flash memory.

The organic flash memory's disadvantage is its short memory retention time of just 24 hours, but the researchers think this could be improved by using a SAM with a longer molecular length, and reducing the size of the transistors.

The results of the research were published in the December 11 issue of the journal *Science*.

More information: Organic Nonvolatile Memory Transistors for Flexible Sensor Arrays, Tsuyoshi Sekitani et al., *Science* 11 December 2009:
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