Polymer Memory – A new way of using plastic as a secondary storage

Mr. Dhiraj Annadate (Alumni 2019-20)
BE-Mechanical

The Polymer memory technology promises to store more data at a lesser cost as compared to the expensive silicon chips used by popular consumer gadgets including smartphones, digital cameras, and other electronic products. The magical ingredient is not smaller transistors or an exotic material cooked up by the semiconductor industry. It is a plastic. This new memory does not use transistors to store information. Instead, bits are written when a strong current passes through a polymer fuse, causing it to blow and change its conductivity.

While experimenting with a polymer material known as PEDOT, Princeton University researcher Sven Moller determined that although the plastic conducts electricity at low voltages, it permanently loses its conductivity when exposed to higher voltages. The PEDOT-based memory card consists of a grid of circuits comprising polymer fuses. A large applied current causes specific fuses to "blow," leaving a mix of functioning and non-functioning connections. When a lower current is later used to read the data, a blown fuse blocks current flow and is read as a zero, whereas a working fuse is interpreted as a one.

Features of Polymer Memory

1. Data stored by changing the polarization of the polymer between metal lines.
2. Zero transistors per bit of storage.
3. Memory is Non-volatile.
4. Microsecond initial reads. Write speed faster than NAND and NOR Flash.
5. Simple processing, easy to integrate with other CMOS.
6. No cell standby power or refresh required.
7. Operational temperature between – 40 and 110°C

Plastic Memory being developed

Researchers at Princeton University working with Hewlett-Packard have invented a new form of permanent computer memory that uses plastic and may be much cheaper and faster than existing silicon circuits. By utilizing a previously unknown property of a cheap, transparent plastic called PEDOT (short name for polyethylene-dioxythiophene); the inventors say that data densities as high as a megabit per square millimeter should be possible

By stacking layers of memory, a cubic centimeter device could hold as much as a gigabyte and be cheap enough to compete with CDs and DVD.PEDOT is an unusual plastic because it conducts electricity, a property that's led to it being used for anti-static coatings.

By putting microscopic pellets of the stuff between two grids of wires, data can be stored by blowing patterns of bits. The memory cannot be rewritten but can be read very fast and with low power consumption. The biggest challenge is developing production techniques. We are hybridizing said the leader of the research group, Princeton professor of electrical engineering Stephen Forrest. We are making a device that is organic the plastic polymer and inorganic thin film silicon at the same time.

Advantages of Polymer memory:

- Plastic memory is fast. Lab built devices with a 1GB storage capacity have yielded read/write cycle times that are 10 times faster than CompactFlash, which are typically 2- 10MB/s read, 1-4MB/s write.
- Memory is Nonvolatile
- Fast read and write speeds

Limitations of Polymer memory:

Turning polymer memory into a commercial product is not an easy process. Memory technologies compete not only on storage capacity but on speed, energy consumption, and reliability. The difficulty is in meeting all the requirements of current silicon memory chips. Until new memory materials are able to compete with the high performance of silicon, their notes, they are likely to be limited to niche applications. One likely use is in disposable electronics, where cost, rather than performance, is the deciding factor.