A

Seminar report

On

Plastic Memory

Submitted in partial fulfillment of the requirement for the award of degree
Of MCA

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Preface

I have made this report file on the topic Plastic memory; I have tried my best to elucidate all the relevant detail to the topic to be included in the report. While in the beginning I have tried to give a general view about this topic.

My efforts and wholehearted co-corporation of each and everyone has ended on a successful note. I express my sincere gratitude to …………..who assisting me throughout the preparation of this topic. I thank him for providing me the reinforcement, confidence and most importantly the track for the topic whenever I needed it.

Acknowledgement

I would like to thank respected Mr…….. and Mr. ……..for giving me such a wonderful opportunity to expand my knowledge for my own branch and giving me guidelines to present a seminar report. It helped me a lot to realize of what we study for.

Secondly, I would like to thank my parents who patiently helped me as i went through my work and helped to modify and eliminate some of the irrelevant or un-necessary stuffs.

Thirdly, I would like to thank my friends who helped me to make my work more organized and well-stacked till the end.

Next, I would thank Microsoft for developing such a wonderful tool like MS Word. It helped my work a lot to remain error-free.

Last but clearly not the least, I would thank The Almighty for giving me strength to complete my report on time.

INTRODUCTION

A new form of permanent computer memory which uses plastic and is much cheaper and faster than the existing silicon circuits was invented by Researchers at Princeton University working with Hewlett-Packard.

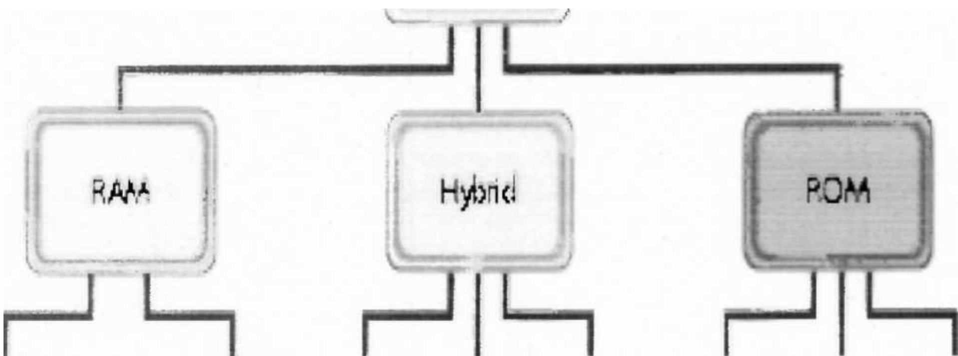
This new memory technology is created by using a conducting plastic which has the potential to store a megabit of data in a millimeter-square device - 10 times denser than current magnetic memories.

This utilizes a previously unknown property of a cheap, transparent plastic called PEDOT - short for polyethylenedioxythiophene. The inventors say that data densities as high as a megabit per square millimeter can 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.

MEMORY

In order to enable computers to work faster, there are several types of memory available today. Within a single computer there are more than one type of memory.

Memory



UKAM SRAM NVKAM FlaA EfcTSOM BPROM PROM Nuked

Figure 1: Common memory types in embedded systems

TYPES OF RAM

The RAM family includes two important memory devices: static RAM (SRAM) and dynamic RAM (DRAM). The primary difference between them is the lifetime of the data they store. SRAM retains its contents as long as electrical power is applied to the chip. If the power is turned off or lost temporarily, its contents will be lost forever. DRAM, on the other hand, has an extremely short data lifetime-typically about four milliseconds. This is true even when power is applied constantly.

In short, SRAM has all the properties of the memory you think of when you hear the word RAM. Compared to that, DRAM seems useless. However, a simple piece of hardware called a DRAM controller can be used to make DRAM behave more like SRAM. The job of the DRAM controller is to periodically refresh the data stored in the DRAM. By refreshing the data before it expires, the contents of memory can be kept alive for as long as they are needed. So DRAM is also as useful as SRAM.

When deciding which type of RAM to use, a system designer must consider access time and cost. SRAM devices offer extremely fast access times (approximately four times faster than DRAM) but are much more expensive to produce. Generally, SRAM is used only where access speed is extremely important. A lower cost-per-byte makes DRAM attractive whenever large amounts of RAM are required. Many embedded systems include both types: a small block of SRAM (a few kilobytes) along a critical data path and a much larger block of dynamic random access memory (perhaps even in Megabytes) for everything else.

Thus DRAM can only hold data for a short period of time and must be refreshed periodically. DRAMs are measured by storage capability and access time.

Storage is rated in megabytes (8MB. 16MB etc). Access time is rated in nanoseconds (60ns, 70ns. 80ns, etc) and represents the amount of time to save or return information. With a 60ns DRAM, it would require 60 billionth of a second to save or return information. The lower the nano speed, the faster the memory operates.

TYPES OF ROM

Memories in the ROM family are distinguished by the methods used to write new data to them (usually called programming), and the number of times they can be rewritten. This classification reflects the evolution of ROM devices from hardwired to programmable to erasable-and-programmable. A common feature of all these devices is their ability to retain data and programs forever, even during a power failure.

The very first ROMs were hardwired devices that contained a preprogrammed set of data or instructions. The contents of the ROM had to be specified before chip production, so the actual data could be used to arrange the transistors inside the chip. Hardwired memories are still used, though they are now called *masked ROMs* to distinguish them from other types of ROM. The primary advantage of a masked ROM is its low production cost. Unfortunately, the cost is low only when large quantities of the same ROM are required.

One step up from the masked ROM is the PROM (programmable ROM), which is purchased in an unprogrammed state. If you were to look at the contents of an unprogrammed PROM, you would see that the data is made up entirely of l's. The process of writing your data to the PROM involves a special piece of equipment called a device programmer. The device programmer writes data to the device one word at a time by applying an electrical charge to the input pins of the chip. Once a PROM has been programmed in this way, its contents can never be changed. If the code or data stored in the PROM must be changed, the current device must be discarded. As a result, PROMs are also known as one-time programmable (OTP) devices.

An EPROM (erasable-and-programmable ROM) is programmed in exactly the same manner as a PROM. However, EPROMs can be erased and reprogrammed repeatedly. To erase an EPROM, you simply expose the device to a strong source of ultraviolet light. (A window in the top of the device allows the light to reach the silicon.) By doing this, you essentially reset the entire chip to its initial unprogrammed state. Though more expensive than PROMs, their ability to be reprogrammed makes EPROMs an essential part of the software development and testing process.

HYBRIDS

As memory technology has matured in recent years, the line between RAM and ROM has blurred. Now, several types of memory combine features of both. These devices do not belong to either group and can be collectively referred to as hybrid memory devices. Hybrid memories can be read and written as desired, like RAM, but maintain their contents without electrical power, just like ROM. Two of the hybrid devices, EEPROM and flash, are descendants of ROM devices. These are typically used to store code. The third hybrid, NVRAM, is a modified version of SRAM. NVRAM usually holds persistent data.

EEPROMs are electrically-erasable-and-programmable. Internally, they are similar to EPROMs, but the erase operation is accomplished electrically, rather than by exposure to ultraviolet light. Any byte within an EEPROM may be erased and rewritten. Once written, the new data will remain in the device forever-or at least until it is electrically erased. The primary tradeoff for this improved functionality is higher cost, though write cycles are also significantly longer than writes to a RAM. So you wouldn't want to use an EEPROM for your main system memory.

Flash memory combines the best features of the memory devices described so far. Flash memory devices are high density, low cost, nonvolatile, fast (to read, but not to write), and electrically reprogrammable.

Flash memory is a solid-state, non-volatile, rewritable memory that functions like RAM and a hard disk combined. If power is lost, all data remains in memory. Because of its high speed, durability, and low voltage requirements, it is ideal for digital cameras, cell phones, printers, handheld computers, pagers and audio recorders.

These advantages are overwhelming and, as a direct result, the use of flash memory has increased dramatically in embedded systems. From a software viewpoint, flash and EEPROM technologies are very similar. The major difference is that flash devices can only be erased one sector at a time, not byte-by-byte. Typical sector sizes are in the range 256 bytes to 16KB. Despite this disadvantage, flash is much more popular than EEPROM and is rapidly displacing many of the ROM devices as well.

The third member of the hybrid memory class is NVRAM (non-volatile RAM). Nonvolatility is also a characteristic of the ROM and hybrid memories discussed previously. However, an NVRAM is physically very different from those devices. An NVRAM is usually just an SRAM with a battery backup. When the power is turned on, the NVRAM operates just like any other SRAM. When the power is turned off, the NVRAM draws just enough power from the battery to retain its data. NVRAM is fairly common in embedded systems.

However, it is expensive, even more expensive than SRAM, because of the battery. So its applications are typically limited to the storage of a few hundred bytes of system-critical information that can't be stored in any better way.

The recent development in the memory was a new form of permanent computer memory which uses plastic and may be much cheaper and faster than the existing silicon circuits which was invented by Researchers at Princeton University working with Hewlett-Packard. This memory is technically a hybrid that contains a plastic film, a flexible foil substrate and some silicon.

The discovery, achieved by HP and Princeton researchers in Forrest's university laboratory, came during work with a polymer material called PEDOT - a clear^ conducting plastic used as coating on photographic film and as electrical contact on video displays.

It was Princeton postdoctoral researcher Steven Moller, now with Hewlett Packard, who found that Pedot conducts electricity at low voltages but permanently loses its conductivity when exposed to higher electrical currents, making it act like a circuit breaker.

This conducting plastic has the potential to store a megabit of data in a millimeter-square device - **10** times denser than current magnetic memories.

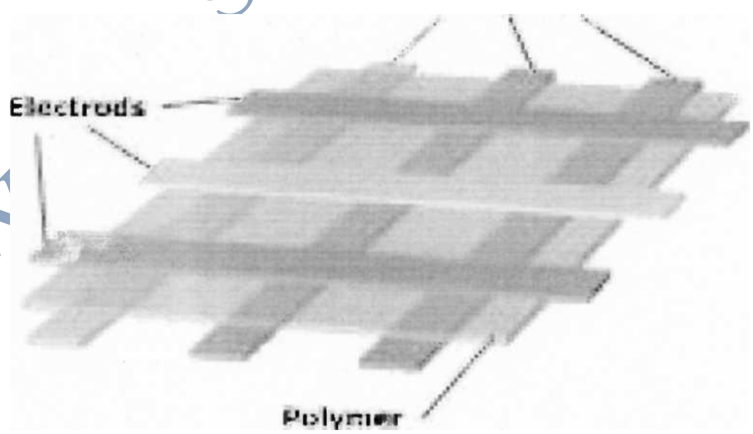


Figure2: Plastic memory

A voltage applied to a given cell can modify the organic nature of the polymer at that spot, changing it from one state to another. And that state can be read at a later I time.

PEDOT when combined with thin-film silicon transistors can store data like a CD and will serve as a conventional electronic memory chip, plugging right into an electronic circuit with no moving parts.

In the new scheme, a single memory cell consists of a layer of thin sheet of polymer sandwiched between gold and an aluminum electrode. In the polymer's original state, positive charges carry current through the material. To encode data in a cell, the researchers apply a voltage, which injects electrons into the polymer. Positive charges from the gold electrode then flood the material to neutralize the electrons.

The movement of charge, which occurs in about a microsecond, permanently switches the polymer from a conducting to a nonconducting state-or from 0 to 1, in computer terminology. To read each cell, the researchers apply a smaller voltage. With the help of a silicon diode that electrically isolates the cell from nearby ones; they then measure the current flowing through the cell

In using Pedot as a storage medium, a device would use a grid of circuits in which all of the connections contain a Pedot fuse. With the introduction of high voltages, the fuses would blow and represent the zeros while unblown fuses would represent the ones that make up computerized data and digital images.

Researchers believe the invention could be the basis for a grid of memory circuits so small that a megabit, or 1 million bits of information, could fit on a square millimeter of paper-thin material.

When put together in a block, the plastic device could store more than one gigabyte of information, the equivalent of 1,000 high-quality images in one cubic centimeter - about the size of a fingertip

The advantage is that we can stack the devices on top of each other.A 1 centimeter cube model device that, in theory, could store 10 gigabits of data, or about double the amount on a CD-ROM.

Thin Film Electronics has developed a specific group of polymers that are bistable and thus can be used as the active material in a non-volatile memory. In other words, the thin film polymers can be switched from one state to the other and maintain that state even when the electrical field is turned off. This polymer is "smart", to the extent that functionality is built into the material itself, like switchability, addressability and charge store. Polymer devices can be sprayed or printed, and are therefore much cheaper than silicon devices, which must be etched.

The plastic memory technology is all solid state based. The absence of moving parts in itself offers a substantial speed advantage compared to all mechanical systems, like magnetic hard disks and optical systems. The polymer film can be read in two modes either destructive or non-destructive.

In the first case, reading speed is symmetric with that of writing. Depending on how the polymer is processed and initialized this speed can range from nanoseconds to microseconds. This speed symmetry puts the thin film memory in a favorable position as compared to non-volatile memory, NAND flash, where the erase before write may be of orders of magnitude slower than the read. In the non-destructive read mode the thin film memory speed is comparable to or better than DRAM read speed.

Stacking is the fundamental strength of plastic memory technology. The thin film memory system is expandable. By the addition of new layers, manufacturers will be able to gain previously unattainable storage capacity within a given footprint.

There are no power-consuming mechanical parts in the thin film system. Furthermore, the polymer memory cells are non-volatile, no refresh (as in DRAM) is required, nor any voltage required from an external power supply to maintain information (as in SRAM). Polymers are robust by nature.

The polymer memory developed by thin film technology has undergone stringent reliability tests at temperatures between -40 and **1** 10°C. The results underline the exceptional stability of the polymer memory and compliance with military and commercial standard tests.

In the thin film system, there is no need of transistors in the memory cells, a substantial simplification compared to state of the art memory designs.

The interesting fact about this idea is its density. Today, a typical S-RAM memory cell takes up between four and six square micrometers of area. By comparison, thin film says that their polymer cells would each occupy but one quarter of a square micrometer - quite a difference.

The scientists say thin film device could be used to produce a single-use memory card that permanently stores data and is faster and easier to operate than a CD.The card would not involve any moving parts, such as the laser and motor drive required by compact discs. Its secret is the discovery of a previously unknown property of a commonly used conducting plastic coating. US scientists at Princeton University, New Jersey, and computer giants Hewlett-Packard combined the polymer with thin-film, silicon-based electronics.

The device would be like a standard CD-R (CD-recordable) disc in that writing data onto it makes permanent changes and can only be done once. But it would also resemble a computer memory chip, because it would plug directly into an electronic circuit and have no moving parts.

PEDOT, which is clear and conducts electricity, has been used for years as an anti-static coating on photographic film. Researchers looked at ways of using PEDOT to store digital information. In the new memory card, data in the form of ones and zeroes would be represented by polymer pixels.

When information is recorded, higher voltages at certain points in the circuit grid would "blow" the PEDOT fuses at those points. As a result, data is permanently etched into the device. A blown fuse would be read as a zero; while an unblown one that lets current passes through is read as a one. The team predicts that one million bits of information could lit into a square millimeter of material the thickness of a sheet of paper. A block just a cubic centimeter in size could contain as many as 1,000 high-quality digital images.

PEDOT

PEDOT is an unusual plastic because it conducts electricity, a property that's led to it being used for antistatic coatings. However, a sufficiently large pulse of current changes it permanently to a nonconducting state, just like a fuse.

It conducts electricity at low voltages, but operates as a semiconductor at higher voltages. The material is a blend of a negatively-charged polymer called PSS- and a positively-charged one called PEDT+. Having distinct charged components enable it to conduct electricity and means it is water soluble.

The team is not sure why it stops conducting when high currents pass through. But according to the Princeton researcher Stephen Forrest, he suspects that the heat produced by a high current gives the PSS- layer sufficient energy to snatch a positively-charged hydrogen ion from any water that has dissolved on its surface, forming a neutral PSSH.

Without the negatively-charged PSS- to stabilize it, PED+ in turn grabs on to an extra electron and also becomes neutral, converting PEDOT into an insulating polymer. In this, bits are written when a current passes through a polymer fuse, causing it to blow and change its conductivity. This involves applying a lower voltage to PEDOT to change its resistance to the conducting material which pushes it into a state of high resistance in which we can store the digital information as ones and zeros.

A large applied current causes specific fuses to blow, leaving a mix of functioning and nonfunctioning 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. Because the storage method involves a physical change to the device, it is also called WORM-write once, read many times-technology.

To store the memory, the researchers use the wires and the diode surrounding 1 the PEDOT blob to run either a high or a low current through it. This either creates an insulator or leaves it as a conductor.

To read the memory, they run current through the top wire and measure the current in the bottom wire. No current means the bit is a zero, and vice versa. By building a grid of intersecting wires they can read and write multiple bits to one device. Here, the result will be an all-organic memory system with manifold advantages: in speed, production, energy consumption, storage capacity and cost.

Thus the researchers of Princeton University and Hewlett-Packard invented a combination of materials that could lower the cost and boost the density of electronic memory.

In the new plastic device, each cell measures 17 square microns. However, researchers predicts that there is room for improvement and their team could get that dimension down to just a couple hundred nanometers. In the future, a small, cube-shaped device could sit in a digital camera and permanently store thousands of photos.

COMPARISON OF PLASTIC MEMORY WITH FLASH

MEMORY

1 - Plastic memory is fast. Plastic memory-built devices with a 1GB storage capacity have yielded read/write cycle times that are 10 times faster than Compact Flash, which are typically 2-10MB/s read, l-4MB/s write.

2 - It requires far fewer transistors, typically only 0.5M (million) for 1GB of storage (!!) compared to silicon's 1.5-6.5B (billion).

3 - It costs about 5% as much to manufacture compared to the silicon-based memory.

4 - It can be stacked vertically in a product, yielding 3D space usage; silicon chips can only be set beside each other.

5 - It has very low power consumption.

6 - The control circuitry only occupies 1-5% of total area occupied by transistors.

7 - It maintains memory even when the power is turned off.

ADVANTAGES OF PLASTIC MEMORY

The plastic memory technology promises to store more data at less cost than the expensive-to-build silicon chips used by popular consumer gadgets including digital cameras, cell phones and portable music players.

The memory cannot be rewritten, but can be read very fast and with low power consumption. So this would be suitable only for permanent storage.

Unlike flash memory found in consumer devices, the new technology can be written to only once, though it can be read many times. It acts in that respect like a non-rewriteable compact disc. But this new memory, which retains data even when there's no power, won't require a power-hungry laser or motor to read or write, and promises more capacity.

PEDOT-based machine could solve the problem of virus hackers, who rely on the fact they cannot afford to leave a trace out of fear of being caught for their dirty work.

With PEDOT-based solutions, hackers would not be able to erase their IP addresses. Instead of rewriting over existing data, PEDOT would just create a static section for incoming data. This ensures that the integrity of data on documents is preserved over long periods of time.

LIMITATIONS OF FLASH MEMORY

The dimension demands on devices increasingly get smaller to host a variety of form factors. Smaller memory space means the transistors leak more electricity and suck up more power.

GOAL OF PLASTIC MEMORY

The goal is to make the technology fast enough to store video. The reaserches hope that this technology will decrease the size, increase reliability and speed up reading and writing of memory chips.

USES OF PLASTIC MEMORY

Polymer devices can be used in data storage devices and also as a switch whose state can be changed externally by a voltage pulse.

CONCLUSION

Plastic memory is much cheaper and faster than the existing silicon a circuit was invented by Researchers at Princeton University working with Hewlett-Packard. Plastic memory is a combination of materials that could lower the cost and boost the density of electronic memory.

It is an all-organic memory system with manifold advantages: in speed, production, energy consumption, storage capacity and cost. The memory cannot be rewritten, but can be read very fast and with low power consumption. So this would be suitable only for permanent storage.

REFERENCES

- www.google.com
- www.wikipedia.com
- www.studymafia.org