Polytronics Technology for Small Scale Microelectronics Industry

K. A. Lathief

Abstract: -For many years plastics were well known merely as INSULATORS and were used predominantly for shielding copper wires. Now the emerging new technology POLYTRONICS, changes our viewpoint in visualizing the conducting polymers as a material of MICROELECTRONICS. Microelectronics technology in conjunction with silicon is flexible enough to easy rolling up of circuits that consume less power and above all they can be manufactured at a fraction of cost involved in making semiconductor chips. This technology has number of upcoming areas of interest where lot of research is going on to manufacture microelectronic components on plastic substrates which would allow manufacturing of gadgets through just printing process.

Keywords:- ***Insulators, Polytronics, Microelectronics***

I. INTRODUCTION

Silicon has largely influenced the Electronics industry and would Continue to do so over a period of time. However, technologists are now looking at other alternatives, mainly "PLASTIC CIRCUITS", to meet our future needs. Here is a look into how plastics would influence the world of electronics. The study of usage of polymeric materials in electronics is termed as "POLYTRONICS".This polyatomic has some advantages over silicon technology. They are

1. Easy Manufacturability (mass production).
2. Low cost.
3. They can be recycled and reused (Decreases environmental stress).
4. Consumes less power.
5. They are mobile, small, and light in weight.
6. They are used to make display devices that have extraordinary picture quality.

The feasibility of developing entire electronic components on basis of polymers is met by "INKJET PRINTING TECHNOLOGY" and is illustrated by several applications such as electronic paper, plastic batteries, etc.

II. Inkjet printing Technology

The huge cost of manufacturing Silicon microchip is due to the large complex processes involved. Photolithographic techniques are used to pattern wafers with microcircuit, which is grown in powerful vacuum, while the wafers are baked at temperatures of several hundred centigrades.Silicon foundries typically use wafers of only one size, each fabricated as a discrete unit that costs billions of dollars for their design and building.

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The INKJET PRINTING TECHNOLOGY provides continuous production line of plastic circuits on plastic substrates and then cut into individual units. The substrates are made of acetate material that is as transparent as vugraph sheets. In this technology the printing work is done at ambient pressure, doing away with many of the costly processes needed for silicon. This printing technology plays a major role in the development of "flat screen" displays.

2.3 Principle of operation

A piezoelectric material expands when a voltage is passed across it, pressing on a reservoir fluid and sending droplets flying out on to the substrates.

Here, the construction of "TOPGATE TRANSISTOR" is explained below.

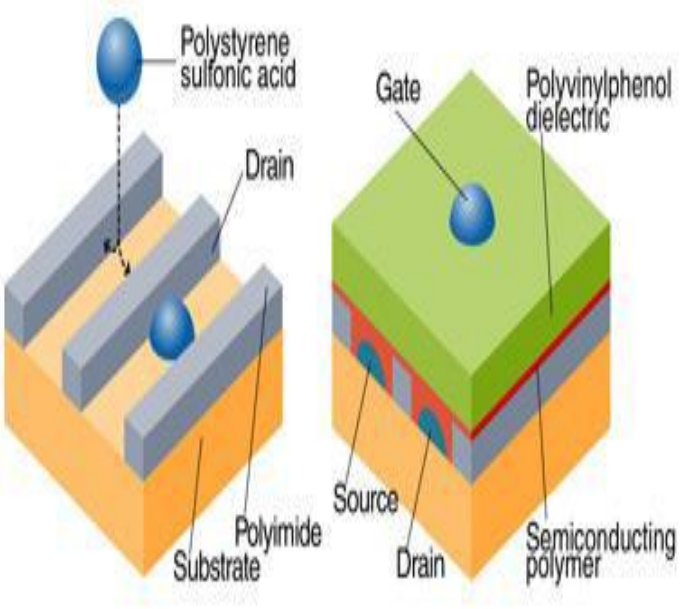


Fig 1.1 Construction of topgate transistor

The water based droplets contain an organic conductor-POLY (3,4- ethylenedioxythiophene) doped with a solution of polystyrene sulphonic acid otherwise known as PEDOT/PSS.As the droplets dry they become a conducting layer and form source and drain of a transistor. They are then coated with a layer of semiconducting polymer (9, 9-dioctyl flourene-co-bithiophene) followed by a dielectric layer of polyvinylphenol. Finally gate is printed, creating a so called top gate transistor. How the semiconductor polymer dries is very crucial. The molecular chains must line up in a way that makes it easy for an electron to hop from one chain to another, but the polymers tend to form into disordered microstructure that reduces electron charge. Resolution of the screen can be improved by coating glass substrate with a hydrophobic film of polyimide pattern. When the water based droplets fall on the surface they are forced away from the

hydrophobic regions in the required pattern.

2.4 Plastic batteries

Plastic batteries are new type of low power batteries that do not require a case and are thin enough to be printed on a paper. They are of low cost and can be mass produced as the battery material is roughly 0.5 millimeters thick. The power source relies on an undisclosed mixture of chemicals to produce 20 milli amperes per hour at a terminal voltage of 1.5 volts for every square centimeter that is printed.

2.5 Construction procedures

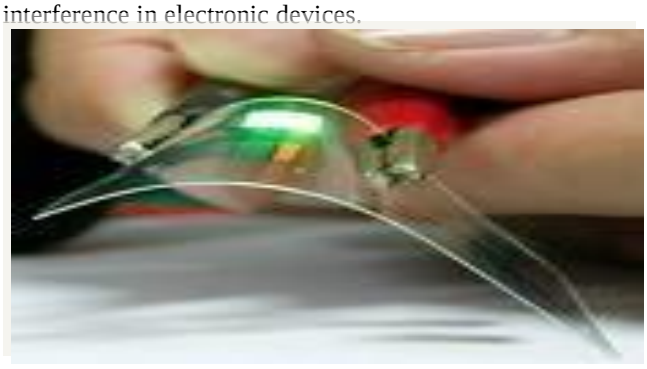
- The new battery consists of 3 different layers.
- It has conventional zinc manganese dioxide components as anode and cathode which are thin foil-like plastic sheets.
- Electrolyte is a polymer gel placed between electrodes.

2.6 Salient features:

- They are non-toxic and non-corrosive making the battery safe to use without casing.
- They are light in weight and can be moulded to any size and shape.

III. ORGANIC LIGHT EMITTING DIODES (OLED):

Unlike traditional LCD's, OLED's are self-luminous and do not require backlighting, diffusers, polarizers or any other baggage that goes with liquid crystal displays. OLED consists of two charged electrodes on the top of some organic light emitting material. This eliminates the need for bulky and environmentally undesirable mercury lamps and fields a thinner, more versatile and more compact display. The low power consumption provides for maximum efficiency and helps to minimize heat and electric interference in electronic devices.



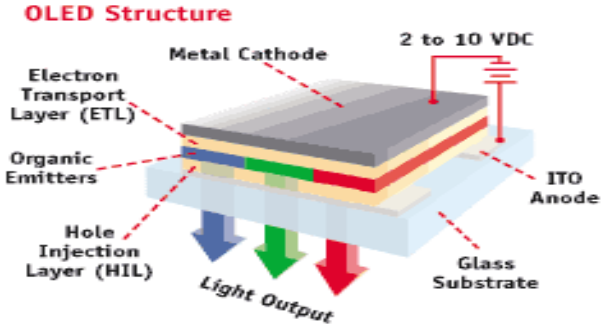
There are two types of OLEDs:
Passive matrix display
Active matrix display

3.1 Passive matrix display:

The passive matrix OLED display has a simple structure and is well suited for low cost and low information content applications such as alpha-numeric displays. It is formed by providing an array of pixels by intersecting anode and cathode conductors.

3.2 Construction:

Organic materials and cathode metals deposited into a "RIB" structure(base and pillar) in which the rib structure automatically produces OLED display panel with desired electrical isolation for cathode lines. The major advantage of this method is that all patterning steps are conventional. So entire panel fabrication process can be easily adapted to large area, high through put manufacturing.

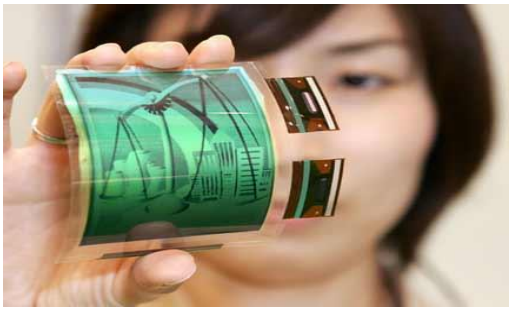


The structure of organic layers and the choice of anode and cathode are designed to maximize the recombination process in emissive layer, thus maximizing the light output from the OLED device.

Advantages:

- Robust design: OLEDs are tough enough to use in portable devices such as cellphones, digital video cameras and DVD players.
- Viewing angles: They can view up to 160°.It provides clear and distinct images even in bright light.
- High resolution: Active Matrix OLED provides high information applications including videos and graphics.
- Electronic paper-oleds are thin due to exclusion of certain hardware goods that normal LCD's require.
- Production advantage: 20% to 50% cheaper than LCD processes.
- The future, quite possibly would consist of these OLEDs being produced like newspapers rather than computer chips.

Electronic paper:



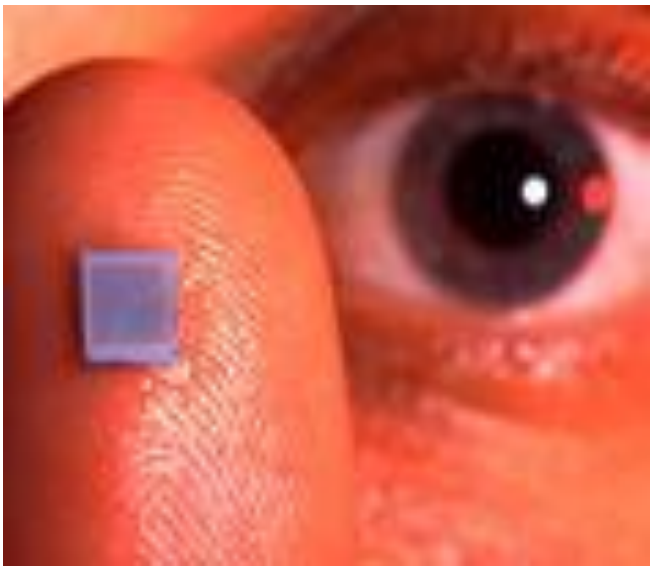
E-paper is a unique type of display whose flexibility, high contrast and bistability give it paper like functionality .These versatile displays are poised for dramatic growth across multiple application especially, in an "always-on" world of mobile broadband. Plastic electronics is the technology of choice for E-paper backplanes, especially for flexible and large displays. This technology overcomes the hurdle to large, high resolution, flexible electronic displays-the backplane. By connecting E-paper to the internet wirelessly with a phone or computer or LAN we can down load favourite newspapers and carry them all on sheet of paper.

Advantages*:*

- Flexibility
- Large size
- Lightness
- Thinness
- Robustness

Rubbery ciruits

These circuits are about 20 times thinner than a human hair and have the potential to be stretched by over half their initial length without lose of electrical conductivity. These are stretchy gold wires are manufactured by electroplating gold on to a sheet of silver, later on the silver is stripped and the wires are encased inside the polymer



Polytronic circuit

The rubber circuits could be woven into the clothes to monitor the heart beat of sports persons for better function, such as artificial nerves that can bend inside the body. These flexible circuits would be less painful to embed in brains of patients suffering from Parkinson's disease to give them a soothing relief by way of electrical stimulations rather than the currently used needles for the treatment.

Electroactive polymer:

The polymers which respond to the electrical stimulation by displaying a significant shape or size displacement are called Electro active Polymers. These polymers have great ability to bend, stretch, twist or contract under the influence of an electrical charge which enables them to behave as natural muscle fibres.

IV. SELF REGULATING RESPONSIVE THERAPEUTIC SYSTEM

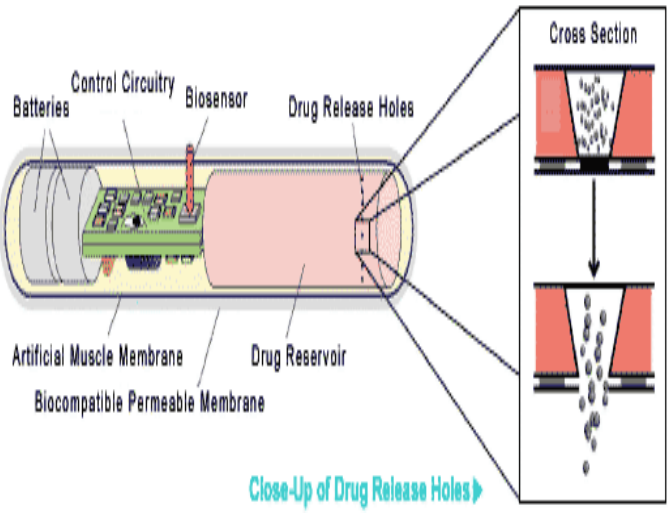


Fig 2.4 Self regulating responsive theraputic system

This system would be implanted into the body to release doses of medication. It is about the size of a small matchstick and it is equipped with the bio-sensor and battery, covered with a series of EAP valves. When ever there is a slight chemical change in the body condition the sensors get activated to signal the battery which then emits an electrical charge to activate the polymer valves causing them to flap open and expose tiny perforations on the capsule surface. The sensors determine the right amount of dosage to be given. With this action, the medication stored in the capsule then seeps through the perforations until the sensor determines that a sufficient amount has been released. When the require dosage is administered the battery again, which triggers the polymer flaps to close. As a result the perforations are covered and the flow of medication stops. With such precise systems in place, scientists hope to find cure to potential diseases such as cancer and diabetes.Small, accurate doses of medication delivered through "NANOBOTS" would help in preventing, if not curing, the disease.

4.1 Polytronics Contributions

Torpedoes contain a large circuitry which is to be protected from water .By using the POLYTRONICS we can make the Torpedo compact as there is no need for protection for the plastic circuitry.

1. Using POLYTRONICS, we can convert a big computer into a single polymer sheet, which contains a OLED display screen and mother board, processor and drivers at the back. This computer has some advantages over the existing computers and lap tops. They are

Water proof
It can easily rolled
Light in weight

2. We can construct a sensor system which can detect the position of submarine.
3. The present cell phones are not water resistance, by using POLYTRONICS we can make them water resistant as well as compact.

V. CONCLUSION

In today's world of ever-expanding technology, Polytronics is going to change the whole world of consumer electronics and form the principal root for the major advancement in the design of electronic circuits and manufacture of printed circuit boards (PCB).The era of polymer electronics has taken a great start and all the technological companies have turned their entire research towards Polytronics. So I conclude that, in the forthcoming years Polytronics will accelerate the pace of the technological advancements and describe a new dimension in the near future.

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Dr. K.A.Lathief received his M.Tech degree in Electronics& Communication Engineering from IASE University Rajasthan from 2005.He received PhD degree in Communication engineering from Magadh University from 2007. Currently working as Professor in the department of Electronics and Communication, Jimma University, jimma Ethiopia. His main research Interests are Communication areas of Satellite, Cellular Mobile, VSAT Networking and Wireless Environments. He has got 15 years of teaching experience. He has published six research papers in various international journals. He has 4 memberships in various international journals.