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A look at the research in the field of plastic electronics: "Polymer challenge"

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Abstract

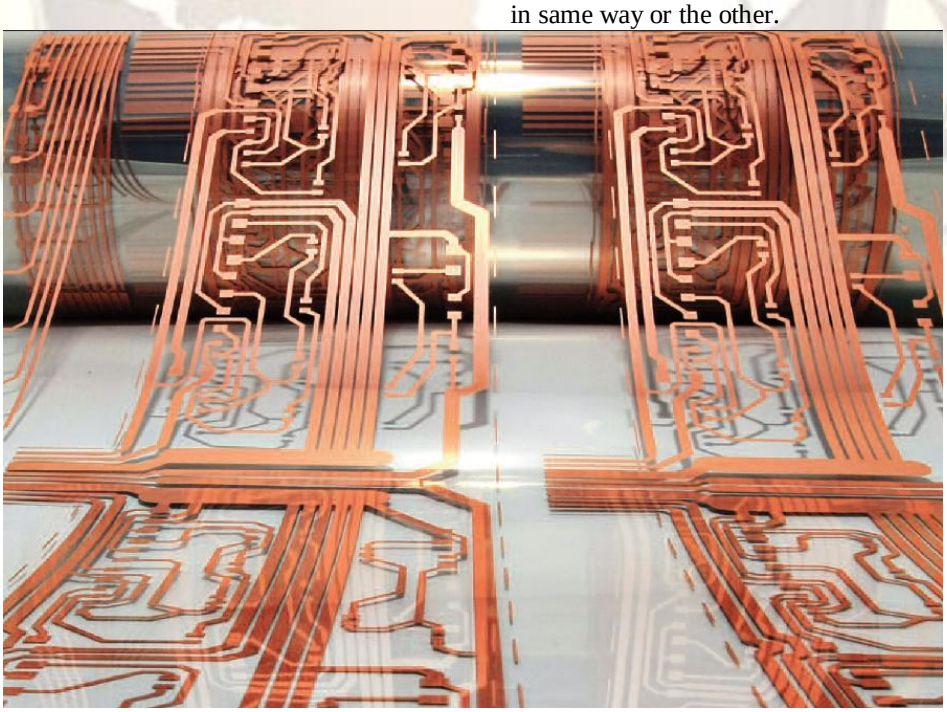
Whenever we talk about clean and green energy alternatives, plastic is the last thing that comes to anyone's mind. How would we feel if the first completely plastic solar cell has created. The field of plastic electronics - a branch of organic electronics that uses organic carbon based polymers which are semi conductive in nature to build electronics instead of silicon.

It was initially difficult to produce plastics which excelled in three attributes, namely translucence, malleability and conductivity. Materials matters a lot when it comes to making plastic conductive. Polymer semiconductors are developed for their own specific application. Another advantage with plastic electronics lies with the sample manufacture process involved. Because of its thin size and ability to bend, it can be installed anywhere as window slides, over cars, on backpack etc. "Plastic electronics is complementary to silicon and is unlikely to replace silicon in applications which are suited to silicon, such as computation". The future should accommodate fast silicon electronics with cheaper plastic electronics.

Keywords: Polymer, plastic electronics, acid processing, etching and lithography etc.

1. Introduction

We are familiar with organic polymers which are all around us in the form of plastic bags, bottles to even solar panels. Plastic electronics basically comprise a plastic substrate made from organic material onto which electronic circuits are printed in the form of flattened sheets. Unlike silicon based electronics, plastic electronics, by their very attributes are much more robust and can easily be flexed or bent while maintaining the conductivity at the same time. Inorganic materials in electronics are brittle in nature and thereby cannot be subjected to flexing without affecting the overall conductivity in same way or the other.

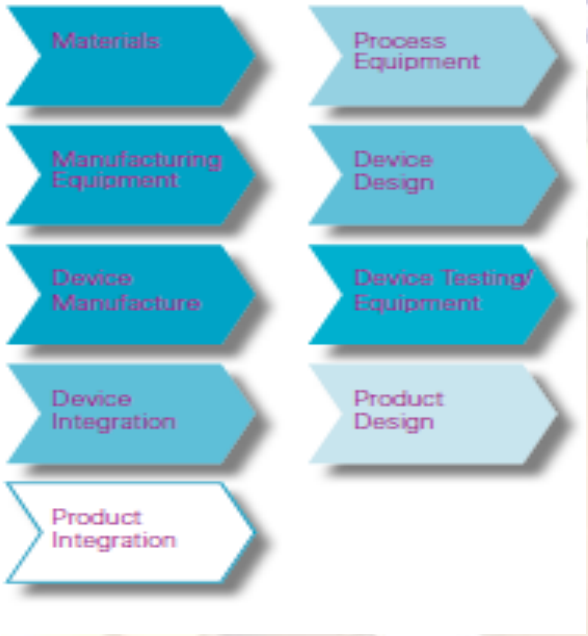


It was initially difficult to produce plastic, which excelled in three attributers, namely translucence (semi- transparent), malleability and conductivity. The first two attributes came by compromising on conductivity. It was eventually discovered that while making polymers moldable their structure were trapped in rigid form thereby preventing electric current to pass through them.

The structures of plastic are relaxed by treating them with an acid after processing.

2. Model

Circuits are made by first coating the polymer material onto a plastic base substrate using a process called spin coating. This involves placing a drop or two of the coating polymer on the substrate which is then spins at a fast speed. The spinning ends up spreading the polymer film evenly on the substrate whose thickness is about 100 nanometer.



This is followed by evaporating gold on the film using a mark which is placed on the polymer film and then put in a gold evaporating contraption. The pattern of the mark determined where the gold will be evaporated. Materials matters a lot when it comes to making plastic conductive.

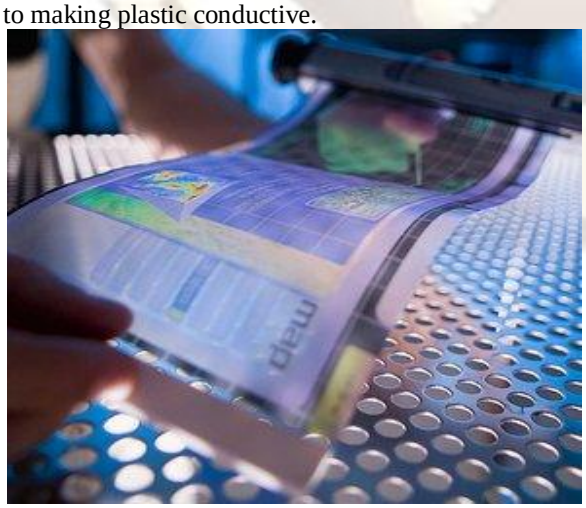


Fig1. Organic based flexible display "Portable hand-held devices"

Cambridge University's Cavendish Professor of physics Richard Friend is one of the pioneers of the study of organic Polymers and electronics properties of molecular semiconductors. "Polymer semiconductor is developed for their own specific application". For example color of light emissions is important in OLEDs where as speed of switching is important in FETs.

At Princeton University, some researchers from the team make new materials, others characterize the structure of there materials and others incorporate these material to understand their potential in certain applications. An example is polyaniline, a conducting polymer which change color when different voltages are applied to it. Such a polymer can be used as a sensor which change color when it comes in contact with a reagent, for instance in purifying water.

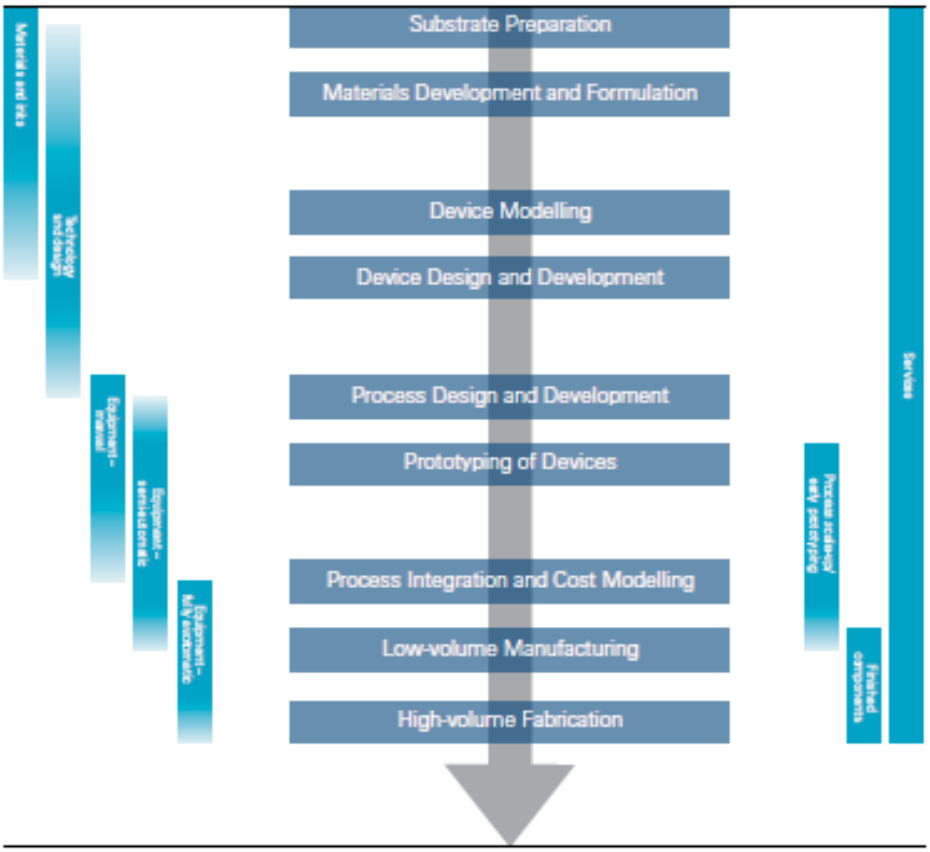
3. Methodology -process description and Application

Very big advantage with plastic electronics lies with the simple manufacturing process involved. Chip makers have to invest in large fabrication plants where silicon-based electronic chips are mass produced under the most cleanest of environment using the most expensive manufacturing process. It requires very high temperatures for processes such as etching, lithography and extremely clean room facilities. We are all familiar with those space-ship type suits, which engineers wear before entering a fab. Polymer based electronics, on the other hand do not need any of the above –mentioned meticulous processes for production. Polymers can be printed out using traditional inkjet printers. Researchers at Georgia Tech's centers for organic photonics and electronics led by Professor Bernard Kippelen have created the world's first plastic solar-cell. By spreading an ultra thin layer of a polymer on the surface of a conducting material produces a strong surface dipole.

This converts the air-stable conductors into efficient electrodes. Conductors such as calcium, lithium, or magnesium are extremely reactive and will stop working when exposed to oxygen as moisture. This is the reason why solar cells are covered with glass as expensive encapsulating materials. With the plastic solar cell, the conductors

can be made of plastic material and will not require any encapsulation. Because of its thin size and ability to band, the plastic solar cell can be installed anywhere- window slides, over cars, on backpack, etc.

Researchers have made plastic electronic based RFID tags which resemble a postage stamp. These tags are capable of transmitting multi- bit digital identification Codes at 13.56 MHz which is the dominant industry standard for RFID tag applications. Belgian nanotech research group Imec, along with its partner has developed a plastic based RFID tag with a reader – talks – first communication protocol. In a shopping mall if many products have such tags, the communicating with the RFID reader will be confusing. According to Imec director Paul Heremans, with the reader – talks first technology when the RFID reader power and contacts the RFID tag on the product, it sends clock and identification data.



Route to production for Plastic Electronics technologies

OLED is already used in cell phone screens and in near future we are going to see a lot of OLED TVs in the market. LG and Samsung already showcased their OLED TVs. Germany head quartered Novaled, a leading firm in OLED simply chain has came out with a brand called liternity to market its OLED product for home use. It will also save you a log of money on your electricity bills.

4. Conclusion

There are still other applications whereby tight sensitive plastics can be used as sensors; flexible materials can make for wearable materials, interactive packaging using thin film OLED screens and so on.

Plastic electronics is complementary to silicon and is unlikely to replace silicon in application which is suited to silicon, such as computation. The future should accommodate fast silicon electronics with cheaper plastic electronics.

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