Flexible Electronic Skin

Abstract

Electronics plays a very important role in developing simple devices used for any purpose. In every field electronic equipments are required. The best achievement as well as future example of integrated electronics in medical field is Artificial Skin. It is ultrathin electronics device attaches to the skin like a sick on tattoo which can measure electrical activity of heart, brain waves & other vital signals.Artificial skin is skin grown in a laboratory. It can be used as skin replacement for people who have suffered skin trauma, such as severe burns or skin diseases, or robotic applications.This paper focuses on the Artificial skin(E-Skin) to build a skin work similar to that of the human skin and also it is embedded with several sensations or the sense of touch acting on the skin. This skin is already being stitched together. It consists of millions of embedded electronic measuring devices: thermostats, pressure gauges, pollution detectors, cameras, microphones, glucose sensors, EKGs, electronic holographs. This device would enhance the new technology which is emerging and would greatly increase the usefulness of robotic probes in areas where the human cannot venture.The sensor could pave the way for a overabundance of new applications that can wirelessly monitor the vitals and body movements of a patient sending information directly to a computer that can log and store data to better assist in future decisions. This paper offers an insight view of the internal structure, fabrication process and different manufacturing processes.

Introduction

Electronics plays a very important role in developing simple devices used for any purpose. In every field electronic equipments are required. The best achievement as well as future example of integrated electronics in medical field is Artificial Skin. It is ultrathin electronics device attaches to the skin like a sick on tattoo which can measure electrical activity of heart, brain waves & other vital signals. Evolution in robotics is demanding increased perception of the environment. Human skin provides sensory perception of temperature, touch/pressure, and air flow.Goal is to develop sensors on flexible substrates that are compliant to curved surfaces. Researcher's objective is for making an artificial skin is to make a revolutionary change in robotics, in medical field, in flexible electronics. Skin is large organ in human body so artificial skin replaces it according to our need. Main objective of artificial skin is to sense heat, pressure, touch, airflow and whatever which human skin sense. It is replacement for prosthetic limbs and robotic arms. Artificial skin is skin grown in a laboratory.There are various names of artificial skin in biomedical field it is called as artificial skin, in our electronics field it is called as electronic skin, some scientist it called as sensitive skin, in other way it also called as synthetic skin, some people says that it is fake skin. Such different names are available but application is same it is skin replacement for people who have suffered skin trauma, such as severe burns or skin diseases, or robotic applications & so on. An artificial skin has also been recently demonstrated at the University of Cincinnati for in-vitro sweat simulation and testing, capable of skin-like texture, wetting, sweat pore-density, and sweat rates

Fig. 1 Artificial Skin

Architecture of e-skin

With the interactive e-skin, demonstration is takes place an elegant system on plastic that can be wrapped around different objects to enable a new form of HMI. Other companies, including Massachusetts-based engineering firm MC10, have created flexible electronic circuits that are attached to a wearer's skin using a rubber stamp. MC10 originally designed the tattoos, called Biostamps, to help medical teams measure the health of their patients either remotely, or without the need for large expensive machinery. Fig 2 shows the various parts that make up the MC10 electronic tattoo called the Biostamp. It can be stuck to the body using a rubber stamp, and protected using spray-on bandages. The circuit can be worn for two weeks and Motorola believes this makes it perfect for authentication purposes.Biostamp use high-performance silicon, can stretch up to 200 per cent and can monitor temperature, hydration and strain, among other medical statistics. Javey's study claims that while building sensors into networks isn't new, interactive displays; being able to recognize touch and pressure and have the flexible circuit respond to it is 'breakthrough'. His team is now working on a sample that could also register and respond to changes in temperature and light to make the skin even more lifelike.Large-area ultrasonic sensor arrays that could keep both robots and humans out of trouble. An ultrasonic skin covering an entire robot body could work as a 360-degree proximity sensor, measuring the distance between the robot and external obstacles. This could prevent the robot from crashing into walls or allow it to handle our soft, fragile human bodies with more care. For humans, it could provide prosthetics or garments that are hyperaware of their surroundings. Besides adding multiple functions to e-skins, it’s also important to improve their electronic properties, such as the speed at which signals can be read from the sensors. For that, electron mobility is a fundamental limiting factor, so some researchers are seeking to create flexible materials that allow electrons to move very quickly.

Ali Javey and his colleagues at the University of California, Berkeley, have hadsome success in that area. They figured out how to make flexible, large-area electronics by printing semiconducting nanowires onto plastics and paper. Nanowires have excellent electron mobility, but they hadn’t been used in large-area electronics before. Materials like the ones Javey developed will also allow for fascinating new functions for e-skins. My team has developed electromagnetic coupling technology for e-skin, which would enable wireless power transmission.Imagine being able to charge your prosthetic arm by resting your hand on a charging pad on your desk. In principle, any sort of conductor could work for this, but if materials with higher electron mobility are used, the transmission frequency could increase, resulting in more efficient coupling.

Fabrication of e-skin

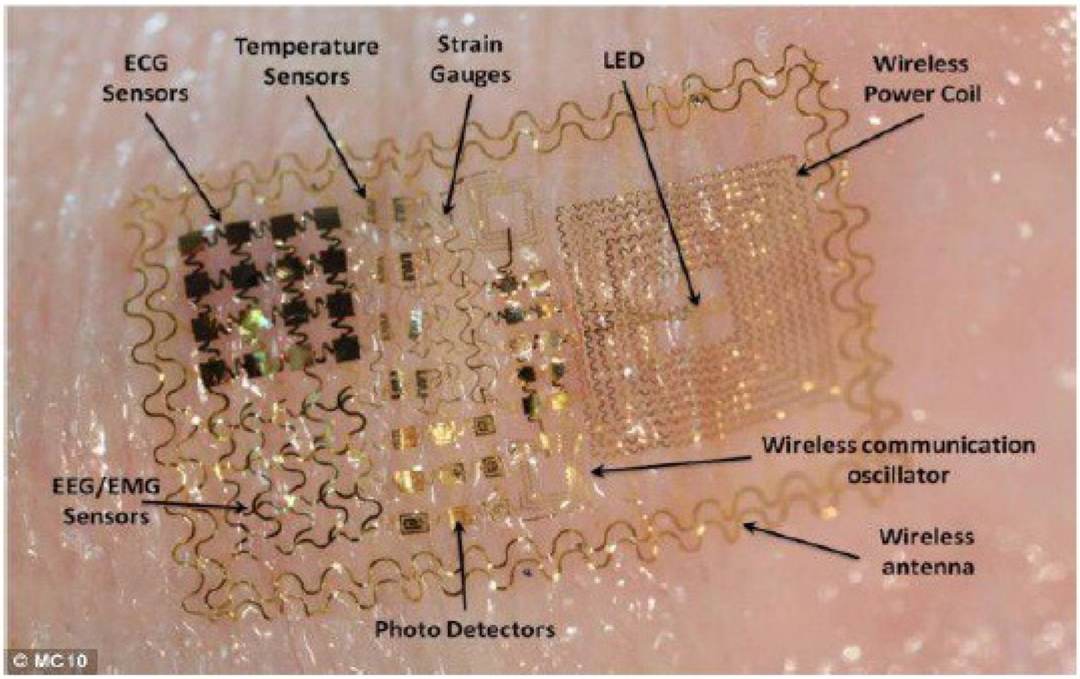


Fig. 2 Architecture of artificial skin

U.S. and Chinese Scientists used zinc oxide vertical nanowires to generate sensitivity. According to experts, the artificial skin is "smarter and similar to human skin." It also offers greater sensitivity and resolution than current commercially available techniques. A group of Chinese and American scientists created experimental sensors to give robots artificial skin capable of feeling. According to experts, the sensitivity is comparable to that experienced by humans. Trying to replicate the body's senses and indeed its largest organ, the skin, has been no mean feat but the need for such a substitute has been needed for a while now, especially in cases of those to whom skin grafts have not worked or indeed its use in robotics.

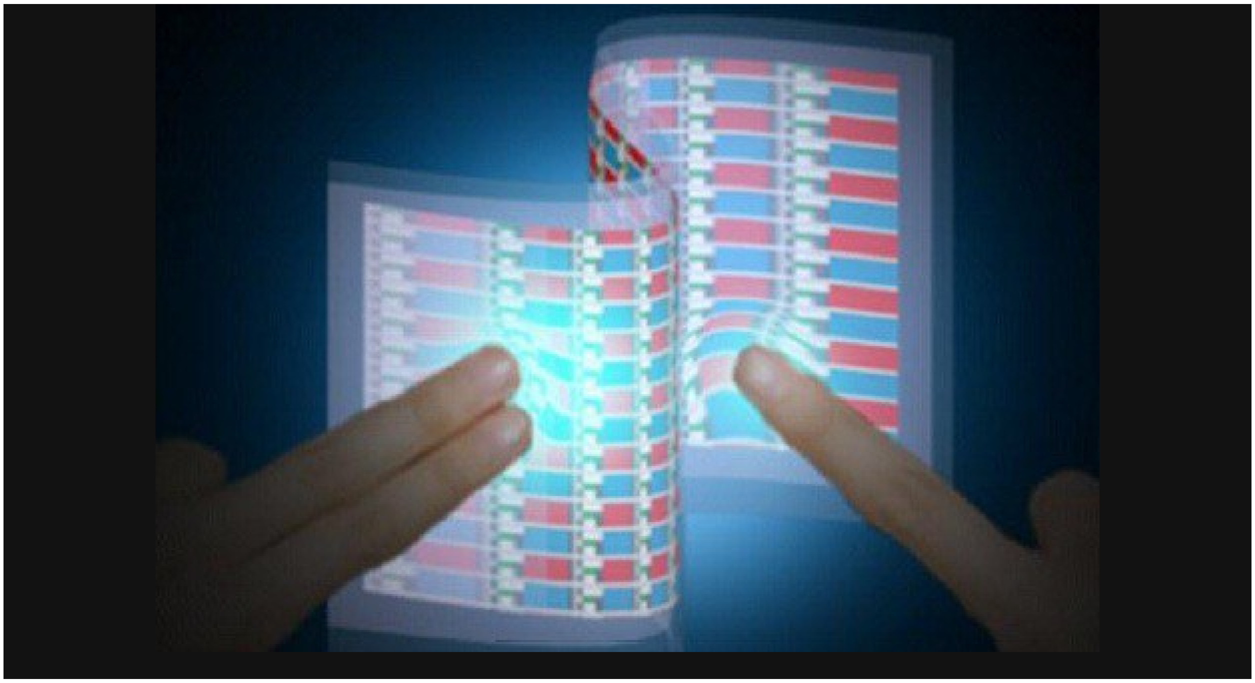
To achieve this sensitivity, researchers created a sort of flexible and transparent electronics sheet of about eight thousand transistors using vertical nanowires of zinc oxide. Each transistor can directly convert mechanical motion and touch into signals that are controlled electronically, the creators explained."Any mechanical movement, like the movement of an arm or fingers of a robot, can be converted into control signals," the Professor Georgia Institute of Technology (USA), Zhong Lin Wang.

This technology "could make smarter artificial skin similar to human skin," said Zhong, after stating that it provides greater sensitivity and resolution. The system is based on piezoelectricity, a phenomenon that occurs when materials such as zinc oxide are pressed. Changes in the electrical polarization of the mass can be captured and translated into electrical signals thereby creating an artificial touch feeling.

By Organic Light Emitting Diode

Javey and colleagues set out to make the electronic skin respond optically. The researchers combined a conductive, pressure-sensitive rubber material, organic light emitting diodes (OLEDs), and thin-film transistors made of semiconductor-enriched carbon nanotubes to build an array of pressure sensing, light-emitting pixels. Whereas a system with this kind of function is relatively simple to fabricate on a silicon surface, ―for plastics, this is one of the more complex systems that has ever been demonstrated,‖ says Javey.

The diversity of materials and components that the researchers combined to make the light-emitting pressure-sensor array is impressive, says John Rogers, a professor of materials science at the University of Illinois at Urbana-Champaign. Rogers, whose group has produced its own impressive flexible electronic sensors (see ―Electronic Sensors Printed Directly on the Skin‖), says the result illustrates how research in nanomaterials is transitioning from the fundamental study of components and simple devices to the development of ―sophisticated, macroscale demonstrator devices, with unique function.‖ In this artist's illustration of the University of California, Berkeley's interactive e-skin, the brightness of the light directly corresponds to how hard the surface is pressed. Semiconducting material and transistors are fitted to flexible silicon to mimic pressure on human skin.



The team is working on samples that respond to temperature. Scientists have created what's been dubbed the world's first interactive 'electronic skin' that responds to touch and pressure. When the flexible skin is touched, bent or pressed, built-in LED’s light up - and the stronger the pressure, the brighter the light. The researchers, from the University of California, claim the bendy e-skin could be used to restore feeling for people with prosthetic limbs, in smart phone displays, car dashboards or used to give robots a sense of touch. Scientists from the University of California have created what's been dubbed the first 'electronic skin' that responds to touch and pressure by lighting up using built-in lights.

Conclusions

The electronics devices gain more demand when they are compact in size and best at functioning. The Artificial Skin is one such device which depicts the beauty of electronics and its use in daily life. Scientists create artificial skin that emulates human touch. According to experts, the artificial skin is "smarter and similar to human skin." It also offers greater sensitivity and resolution than current commercially available techniques. Bendable sensors and displays have made the tech rounds before. We can predict a patient of an oncoming heart attack hours in advance. In future even virtual screens may be placed on device for knowing our body functions. Used in car dashboard, interactive wallpapers, smart watches.

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