Electronic Skin: Definition, Technologies And Ways Of Usage

People must now produce electronic skin technology

Electronic skin is a hot topic in engineering and a very new technology. This is why people don't have too many immature technologies right now. People now have the technology of using quantum tunneling composites called QTC or using rubber, conductive graphite and new transistors.

First, American scientists produced a quantum tunnel composite called QTC. The system is simple in structure, can be processed into various shapes, and can be fixed to clothes like clothes. Prepare the surface. The key to its technology lies in a quantum tunnel composite called QTC. As Ramesh said in 'Quantum Tunnel Composites,' QTC pills can be used as input sensors in response to applied forces, and these pills can also be used in devices to control higher currents than QTC sheets. Compared with similar materials in the past, QTC materials can not only sense the hardness of an object, but also the hardness level of an object. In addition, with XY scanning technology, robots using QTC technology can also obtain comprehensive sensory information from different areas such as the forearm, shoulders and torso.

Second, the use of rubber, conductive graphite and new transistors is a technology that people now have. This is another method created by Japanese scientists. As early as 2003, the Japanese research team used low-molecular organics and pentacene molecules to make thin films and sensed the electronic pressure of the skin through the surface of the pressure sensor. Hasegawa Tatsuo and Jun Takeya pointed out in their article 'Using Single Crystal Organic Field Effect Transistors' (2009) that pentacene is a popular choice for organic thin film transistors and OFET research. Due to its hole mobility in the OFET of up to 5.5 cm2 / V, it is the most intensive conjugated organic molecule with high application potential. The electronic skin incorporates an electrically inductive graphite sheet into the rubber polymer. When touched, its resistance changes, and a series of transistors hidden under the surface of the skin immediately notice these changes. The main difficulty is that the device's response becomes as flexible as real human skin and will eventually be worn on the robot's arm. The transistors of conventional microchips are made of silicon material and are hard and brittle. But Japanese scientists use a soft organic material called pentacene instead of making transistors. Zou and his team point out in the article 'Recoverable, fully recyclable and malleable electronic skin through dynamic covalent thermoset nanocomposites' (2018) that polymer networks can pass hydrogen bonding or dynamic covalent chemistry. Promotes a dynamic healing process, but the combination of inorganic particles can greatly extend the functionality of polymer-based materials in electronic skin applications. The electronic skin sensor system consists of a 32*32 square soft material transistor with 2.5 square millimeters per transistor. Scientists hope to make transistors that are 100 times smaller than this. This electronic skin can be bent a lot without damaging the transistor, and it can continue to work even if it is wrapped on a 2 mm diameter rod.

This new technology is not yet mature. The main technology that people now have is the use of

quantum tunneling composites called QTC or the use of rubber, conductive graphite and new transistors. In the future, scientists will find more ways to produce electronic skin. By then, electronic skin will benefit people in many different fields.

People are now commonly used to produce electronic skin materials

Electronic skin is a hot topic in engineering and a very new technology. Nowadays, people don't have much material to produce electronic skin. Quantum tunnel composites and polymer-based materials are materials commonly used to produce electronic skin.

First, quantum tunnel composites are composites of metallic and non-conductive elastomeric adhesives used as pressure sensors. They use quantum tunnels: in the absence of pressure, the conductive elements are too far apart to conduct electricity. When pressure is applied, they move closer and electrons can tunnel through the insulator. Since the classical resistance is linear and the quantum tunnel varies exponentially with decreasing distance, this effect is much more pronounced than would be expected using the classical effect alone. Quantum tunnel composites have multiple names in the professional literature. For example, Duan, Ling Yan; Fu Sirui Deng Hua, Zhang Qin, Wang Ke, Chen Feng, Fu Qiang, Conductive or semi-conductive polymer compounding in “Resistivity-Strain Behavior of Conductive Polymer Composites: Stability and Sensitivity” (2014) The material is called QTC material. Another example is Wang Luheng's use of piezoresistive sensors and force sensing resistors in the 'piezoresistive sensor based on conductive polymer composites and lateral electrodes' to be called QTC materials. However, in some cases, the force sensing resistor may operate primarily in a seepage state. This means that as the applied stress or force increases, the composite resistance increases. The form of QTC is different, the usage of each form is different, but the resistance changes during deformation are similar. QTC pills are the most commonly used QTC type. The pill is a pressure sensitive variable resistor. The amount of current passed is exponentially proportional to the applied pressure. The QTC pellet can be used as an input sensor in response to the applied force. These pills can also be used in equipment to control higher currents than QTC sheets. The QTC board consists of three layers: a thin QTC material, a conductive material and a plastic insulator. QTC thin plates enable fast switching from high resistance to low resistance and vice versa.

The second material is a polymer-based material. Zou and his team published a study in 2018 on the re-formation of covalent bonds in electronic skin when damaged. The study pointed out that electronic skin is considered repairable due to 'reversible key exchange,' meaning The bonds that connect the networks together may break and reshape under specific conditions such as solvation and heating. The repairability and reusability of such thermoset materials is unique because many thermoset materials crosslink the network by covalently irreversible topography. In polymer networks, the bonds formed during healing are indistinguishable from the original polymer network. Dynamic non-covalent cross-linking has also been shown to form repairable polymer networks. In 2016, Oh and his team of semiconductor polymers for organic transistors were specifically studied. They found that the incorporation of 2,6-pyridinedicarboxylic acid (PDCA) into the polymer backbone imparts self-healing ability based on the hydrogen bond network formed between the groups. By incorporating PDCA into the polymer backbone, the material is able to withstand strains of up to 100% without signs of microcracking. In this example, as the strain increases, hydrogen bonds can be used for energy dissipation.

Quantum tunnel composites and polymer-based materials are materials commonly used to produce electronic skin. Although people don't have a lot of materials to produce electronic skin, scientists are still working hard. More materials will be available in the future.

The Fields Electronic Skin Application Now

Electronic skin is a hot topic in engineering and a very new technology. People are trying to apply it to more areas. Currently, electronic skin can be used in the medical and robotics fields.

The first application is in the medical field. Electronic skin has the ability to simulate, restore and even replace human skin. To this end, scientists must first make them feel and feel, which means the same basic pressure as human skin, and is the most basic function of conducting tactile signals. Researchers at the University of Cambridge in the UK are experimenting with transplanting randomly stretched and deformed circuits onto transparent, flexible silicones to give electronic skin more physical properties similar to human skin. According to the design, this electronic skin can wrap around limbs and arms and is expected to be applied to skin grafts. However, before the electronic skin is truly transplanted into the body, the physiological functions and structural problems inside the skin must also be considered. According to current medical research, it has been found that the human body may refuse to use it when performing a skin graft. Immune recognition and rejection of allogeneic skin grafts (2013) indicate that transplantation of allogeneic skin grafts is associated with an effective immune response leading to donor cell destruction and graft rejection. The electronic skin and the surrounding normal skin of the nerves, muscles, lymph and gland and other harmonious symbiosis, feedback of tactile feedback information to the nerve cells, and accept the precise transmission of nerves, this is the direction of scientists.

The second application is in the field of robotics. The tactile sensor enables the robot to interact with people and the environment with high precision. Tactile robots (2016) point out that tactile sensations provide important information about the position of an object in the hand while controlling the handling and manipulation of the object. However, the development of touch in robotics is an engineering challenge. Currently, the way to make a robot feel tactile is to cover different parts of the robot with electronic skin and respond to mechanical and other environmental stimuli through the sensor. But this approach requires system-level development from materials and electronics to communication and processing. From industry to healthcare, robots equipped with tactile sensations may have many different applications, each setting specific requirements and trade-offs within the operating force, frequency and resolution range. In general, large deformations of the sensor material allow for more accurate measurement of external forces. Such components should be reliable and reliable as they generally protect electronic equipment from impact, scratches, and dust and water. High sensitivity must be balanced, which is critical for any artificial equipment used in a home or industrial environment every day. In addition, the response of the sensor should not change with time or temperature and should have a hysteresis close to zero.

All in all, although people can use electronic skin in both medical and robotic fields, it is still immature. Scientists also need to study many of these technologies. One day, people will have more mature technology to apply electronic skin.