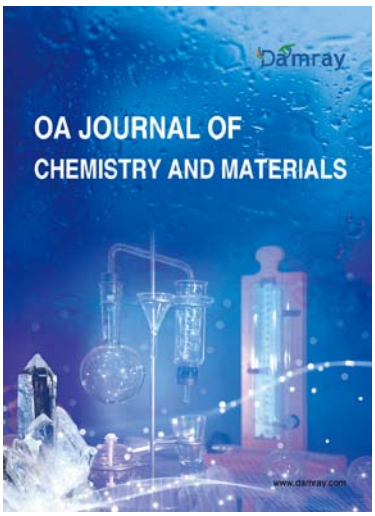
Research Progress of Molecular Structure and Properties of Organic Semiconductor Materials



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Abstract

This article starts from organic semiconductor materials and the effective exploration of their molecular properties and structure. It can be known that organic molecules are an important part of organic semiconductor materials, which are different from traditional semiconductor materials, and carbon-carbon double bonds are organic Necessary factors for the molecular structure in semiconductor materials, and the carbon-carbon double bond structure in the molecular structure of organic semiconductor materials will continue to expand to many adjacent atoms, so it is divided into two types of small molecules and polymers. The conductivity is between the metal and the insulator. The doping method can be used to change its conductivity type and conductivity. Its performance and usefulness are obvious. Based on this, this paper focuses on the research progress of the molecular structure and properties of organic semiconductor materials.

Keywords

Semiconductor, Material molecule, Structure, Performance, Research progress

Introduction

Compared with inorganic semiconductor materials, it can be seen that organic semiconductors are easier to obtain raw materials for preparation, and their properties can also be effectively improved by changing functional groups. Therefore, the hot spot in the field of semiconductor research at this stage is organic semiconductors.

1. An overview of molecular structure research of organic semiconductor materials

The molecular units of repetitive organic semiconductor materials can be divided into small molecule type and polymer type. In general, the small molecule organic semiconductor materials are composed of a large conjugate system

without alternating chain structure fragments. Such as three phenyl amines, phthalocyanine, pentacene, fullerene and photoluminescence belong to a common type of small molecule organic semiconductor materials, and aromatic ring, polyacetylene and copolymer type belong to common polymeric organic semiconductor materials, and the like poly (thiophene, polypyrrole, polystyrene, polyaniline type belong to a part of the aromatic ring. In general, organic semiconductor materials tend to be of infinite types because organic molecules themselves are infinitely modifiable.

Carriers are divided into holes and electrons in organic semiconductor materials, and they transport holes and free electrons in the conduction band and valence band of the material, respectively. Under normal circumstances, most organic semiconductors are P-type, which can only conduct positive charges, and the molecular configuration of organic semiconductor materials will change after the introduction of positive charges. For example, the simplest conjugated polymer, such as polyacetylene, is composed of carbon-carbon double bonds and alternating single bonds to form its molecular chain, and two different types of molecular configurations can exist on the molecular chain at the same time. The segment configuration can be transformed from one type of molecular configuration phase to another type of molecular configuration phase by overcoming the torsional energy barrier when the polyacetylene molecular chain is thermally excited. When these two phases can exist behind the same molecular chain, it enables domain walls to be confined to their junctions. The excited energy state is represented by the domain between the two and can be transferred in the molecular chain.

2. Overview of molecular properties of organic semiconductor materials

Carriers are highly delocalized in organic semiconductors and move directionally in continuous valence bands and conduction bands under the action of applied voltage. The van der Waals forces between molecules in organic semiconductor materials are relatively weak, and a molecule is the extent and degree of delocalization of carriers. The charge carrier will delocalize between several neighboring molecules only in the single crystal material of organic semiconductor. Therefore, the charge in the amorphous organic semiconductor material needs to be effectively transferred between different molecules by jumping mode. The degree of overlap between adjacent molecules is closely related to the efficiency of jump transport, and the speed of jump transport will accelerate with the increase of overlap degree. Obviously, the transport efficiency of inorganic semiconductor is much higher than jump transport, so the transport efficiency of carriers in organic semiconductor materials is often not high.

The migration efficiency of carriers in inorganic semiconductors decreases with the gradual increase of temperature, because the increase of temperature will gradually increase the defects of materials, and thus effectively improve the recombination probability of carriers. The difference is that the carrier transport efficiency in amorphous organic semiconductor materials increases with the increase of temperature in a certain range, which means that the essence of carrier transport mechanism in inorganic semiconductor materials and organic semiconductor materials is different. Carriers can take the conjugate orbital of each organic molecule as each bound region, so jumping from one region to another is hop transport, of course, on the premise of escaping from one bound region before jumping into other bound regions. Thermal excitation is a necessary factor to escape from the bound region, so the migration rate of carriers in organic semiconductors increases with the rise of temperature within a certain range. In addition, the migration efficiency of carriers in organic semiconductor materials will also be affected by the degree of material doping. When reducing agents or oxidants are introduced into organic semiconductors, the carriers generated thus belong to bipolarons and polarons, which is called doping. Through a lot of practical studies, it can be known that the doping can be used as a bridge between organic molecules, so as to rapidly transform the carrier from a conjugated silent interior to a conjugated region. Therefore, in general, carriers in organic semiconductor materials can be significantly improved by appropriate doping transfer efficiency.

3. Conclusion

The rapid development of organic semiconductor materials in recent years is inseparable from the collaboration and joint efforts of researchers in physics, chemistry and electric power, which is the result of their hard work. But this is just the beginning of what people know about organic semiconductors. Organic semiconductor materials have been widely used in device research due to their molecular structure properties, and the participation of multiple disciplines and multi-disciplines has promoted the good development of organic semiconductor materials.

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