# Conductive polymer, how does it work, what is its potential in applied electricity?

REVIEW AND FINAL EVALUATION

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## Background

When we discuss the conductivity of conductors or semiconductors in different environments and conditions, we generally assume that the material is metallic. That is probably because we did not understand modern physics then as we do now, in atom terms. Electrical conductance required free electrons, and we know as a fact on the basis of physics and chemistry, non-metallic materials too, can have free electrons in certain conditions.

## Introduction

Conductive polymers are organic polymers that conduct electricity. It was first described in Polyaniline in mid-19th century by Henry Letheby, and developed gradually since then. Not until recently in 2000, when a Nobel Prize in Chemistry is given for the discovery and development of high conductive oxidized iodine-doped polyacetylene, conductive polymers has come under the spotlight of electrical field.

## Break down of  the original question:

1. What is electric current in atom terms and how is it related to the conductivity of metallic and nonmetallic materials?
2. How can non-metallic material support the mechanism from question 1
3. Applications and feasibility of non metallic conductors and semiconductors, and how is it compared to conventional metallic conductors and semiconductors?

# Answers

1. As we already know, an electric current is a flow of electric charges which are, in the area we are discussing, carried by electrons.

   Thus, electric current in conductive materials is the flow of electrons from atom to atom.

   How electrons are held in the atom structure determines the conductivity of the material. In metallic atom, electrons are held loosely, meaning that they can move freely in the matter. Meanwhile, in non-metallic materials, outer electrons are held very closely to nucleus, result in very little or no conductivity

2. Non-metallic material being discussed in this case, is conductive polymers.

   As we already know polymers (e.g.  plastics) as long chain of repeating unit of monomer. There are two factors which make a certain type of polymer a conductive polymer:

   a. The polymer must consist of in alternating single and conjugated double bonds.

      This structure can be found in for example: polyacetylene, polyaniline, polypyrrole, etc… The key here is the conjugated double bond, also known as the  bond.

      While the single bond (or  bond) holds the atom together by concentrating the electrons between atoms, the  bond strength the connection between atoms by attracting electrons above and below the molecules.

      This strengthening create the basis for electricity current introduced in the second factor.

b. The other crucial factor is doping. While doping can help create semiconductor materials from already conductive metallic materials, it also help enhance the conductivity of polymers.

Doping can remove electrons from the outer space of the atoms, allowing the remaining electrons of the current orbital to freely move. Doping can also add electrons to force the atom to create another orbital, in which the new electrons is now the “remaining” of the new orbital can also move freely.

3. Technically, conductive polymers can be applied in all the use cases of conventional metallic materials. While metal mining, processing, and shipping can be expensive, conductive polymer is the most attractive alternative at the moment, because they are light, cheap, and easily made flexible.

However, researchers have yet to find a large-scale, consistent and environmental friendly method to process and create conductive polymers. Currently industrial applications of conductive polymers are:

a. Organic transistors
b. Organic LED
c. In flat panel display
d. Organic solar cells

Because of its potential in antistatic materials, other uses of conductive polymers, which are still in research and development: antistatic coating, antistatic substance for conventional photographic film, highly compact capacitor, etc...

# Bibliography

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