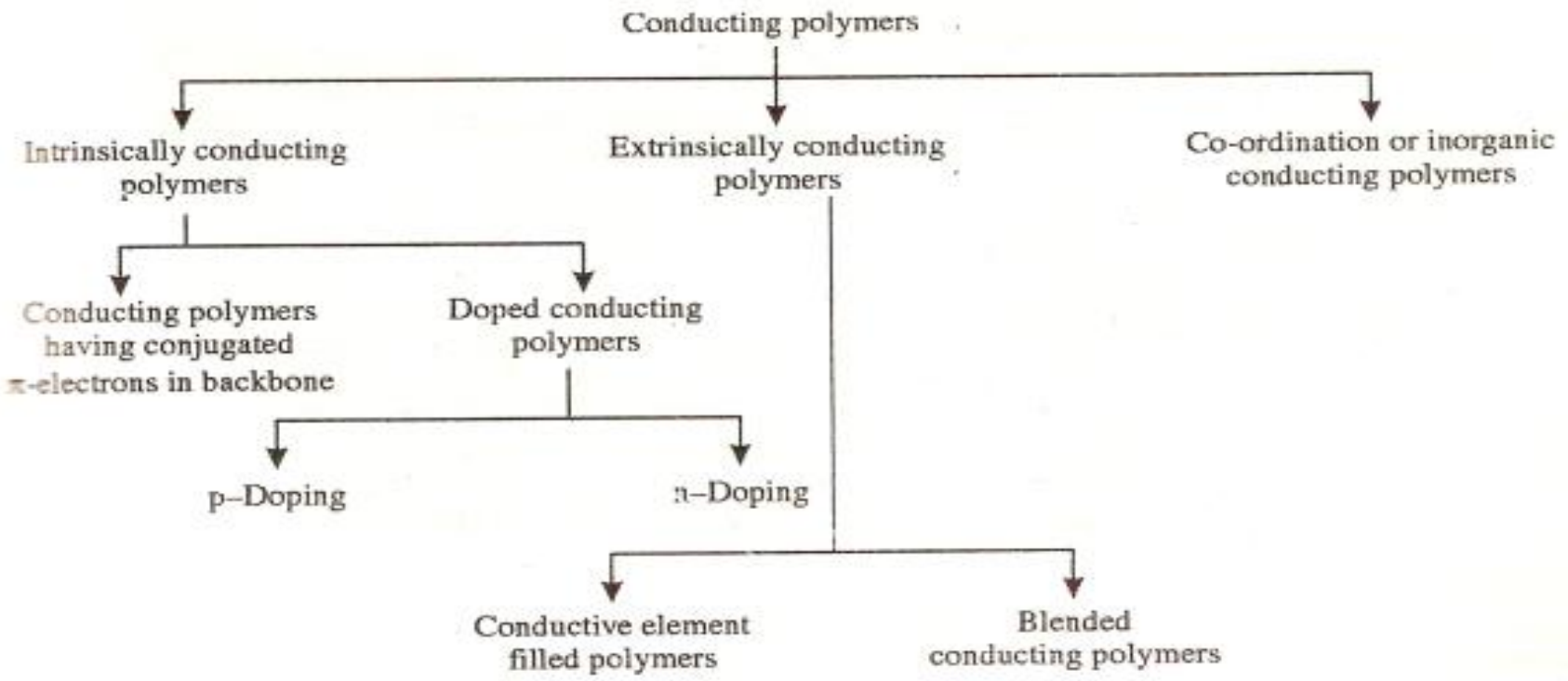
POLYMERS

CONDUCTING POLYMERS : Polymers which can conduct electricity are called conducting polymers. Ordinary polymers obtained by usual methods are nearly insulators. However, some specific polymers may act as conductors.

Classification: Conducting polymers may be classified as



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1. Intrinsically conducting polymers :

These types of polymers have a solid backbone made up of extensive conjugated system, which is responsible for conductance. They may be of two types:

(i) Conducting polymers having conjugated π-electrons in the backbone : These polymers essentially contain a conjugated π-electron backbone responsible for electrical charge. Under the influence of electrical field conjugated π -electrons of the polymer get excited, which can then be transported through the solid polymer. Fulther, overlapping of orbitals of conjugated π -electrons over the entire backbone results in the formation of valence bands as well as conduction bands, which extend over the complete polymer molecule. The presence of conjugated π -electrons in polymers increases its conductivity, *e.g.,*

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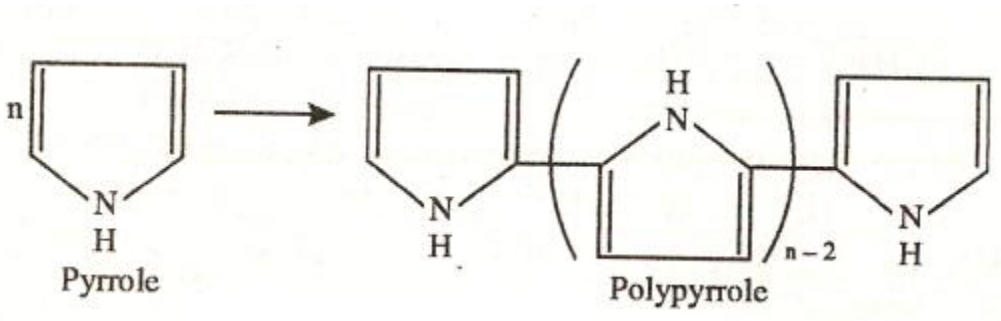
Polypyrrole



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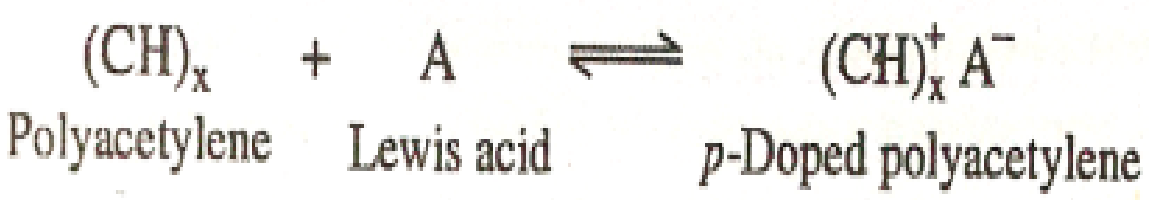
(ii) Doped conducting polymers: The conducting polymers obtained by exposing the polymer to a charged transfer agent in either gas phase or in solution are called *doped conducting polymers.*

Doping is the process by which conductivity of the polymers may be increased by creating negative or positive charge on the polymer backbone by oxidation or reduction.

Doping may be of two types:

(A) p-Doping : It is done by oxidation process. In this process, the conducting polymer is treated with a Lewis acid.



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(B) n-Doping : It is done by reduction process. In this process, the conducting polymer is treated with a Lewis base.

$(CH)_x + B \rightleftharpoons (CH)^-_x B^+$

Polyacetylene Lewis base n-Doped polyacetylene

Advantages of intrinsically conducting polymers :

(i) Their conductivity

(ii) Their ability to store a charge.

(iii) Their ability to undergo ion exchange.

(iv) They can absorb visible light to give coloured products.

(v) They are transparent to X-rays.

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Limitations of intrinsically conducting polymers:

(i) Their conductivities are poorer than metals.

(ii) Their improcessability.

(iii) Their poor mechanical strength.

(iv) They are less stable at high temperatures.

(v) On storage they lead to loss in their conductivity.

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2. Extrinsically conducting polymers :

Those conducting polymers which owe their conductivity due to the presence of externally added ingredients in them are called *extrinsically conducting polymers.* They are of two types :

(i) Conductive element filled polymers : In this type, polymer acts as a binder to hold the conducting elements together in solid entity.

The minimum concentration of the conductive filler, which is added to let the polymer start conducting is called the *percolation threshold.*

Important characteristics of these polymers are : (a) They possess good bulk conductivity.

(b) They are cheaper.

(c) They are light in weight.

(d) They are mechanically durable and strong.

(e) They are easily processable in different forms, shapes and sizes.

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(ii) Blended conducting polymers: These types of polymers are obtained by blending a conventional polymer with a conducting polymer either physically or chemically. Such polymers can be easily processed and possess better physical, chemical and mechanical properties.

3. Coordination or inorganic conducting polymers :

These polymers contain charge transfer complexes and are obtained by combining metal atoms with polydentate ligands.

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Applications of conducting polymers: Conducting polymers are widely used :

1. In rechargable batteries.
2. In making analytical sensors for pH, O_2, SO_2, NH_3, glucose, etc.
3. In the preparation of ion exchangers.
4. In controlled release of drugs.
5. In optical filters.
6. In photo voltaic devices.
7. In telecommunication systems.
8. In micro-electronic devices.
9. In bio-medical applications.