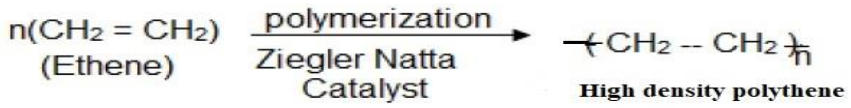
4.1.1POLYETHYLENE

Polyethylene is made by addition or radical polymerization of ethylene (olefin) monomers.

Preparation:



Types of Polyethylene (PE):

Low-density polyethylene (LDPE)
High-density polyethylene (HDPE)

PROPERTIES:

- Higher tensile strength compared to other forms of polyethylene
- Low cost polymer with good processability
- Good low temperature resistance
- Temperature resistance up to 80°C continuously and 95°C for shorter times.
- Low cost polymer with good processability
- High impact strength at low temperature, good weatherability
- Excellent electrical insulating properties
- Very low water absorption
- FDA compliant
- Transparent in thin film form

USES:

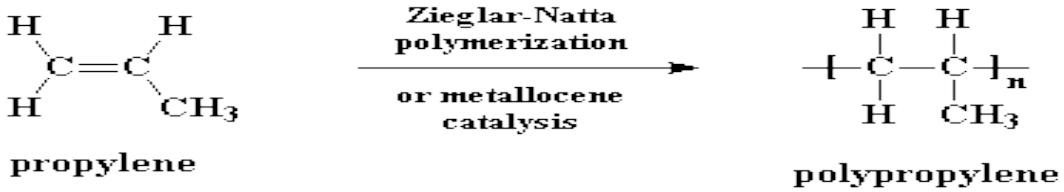
It is used in the field of pipe fittings, wire cables, fuel tanks, packaging…

DISADVANTAGES:

- Susceptible to stress cracking
- Lower stiffness than polypropylene
- High mould shrinkage
- Poor UV- and low heat resistance
- High-frequency welding and joining impossible

4.1.2 Polypropylene:

Preparation:



Properties:

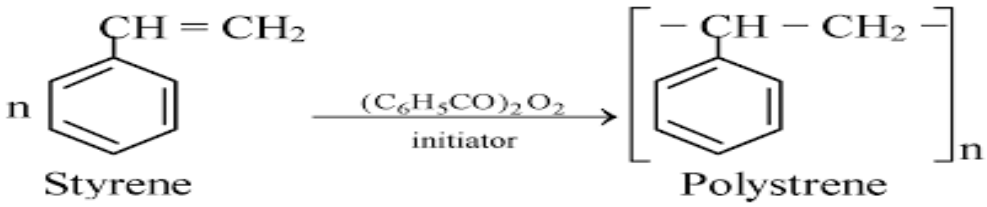
- Resistant to heat distortion
- Excellent electrical properties
- Chemically inert
- Inexpensive and poor resistance capacity

Uses:

It is used in TV cabinets. luggage's, packing films, sterilized bottles.

4.1.3 polystyrene

Preparation:



Properties:

- Good dimensional stability even at low temperature
- Good toughness
- High elongation, high resistance to stress cracking.
- Lower hardness and rigidity than by alcohols, ketones, ethers etc.

Uses:

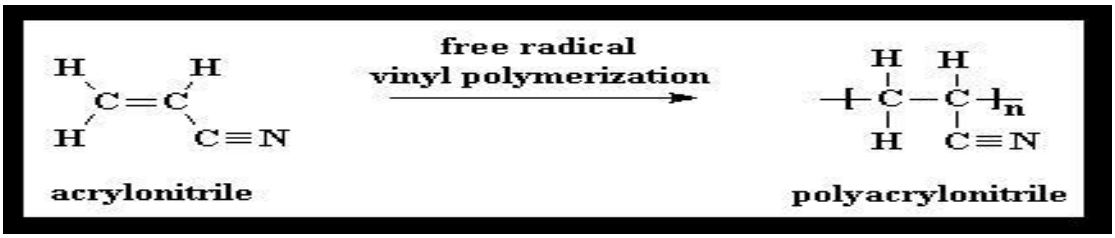
- Mainly used for the manufacture of motor tyres.
- Floor tiles, gaskets,foot-wear components
- Tank linings, insulation for high voltage wire and cables.

4.1.4 polyacrylonitrile

Preparation

It is also called as polyvinyl cyanide.it is produced from acrylonitrile by the radical polymerization technique using peroxide initiators.

Acrylonitrile can be obtained by from acetaldehyde and hydrogen cyanide.



Properties:

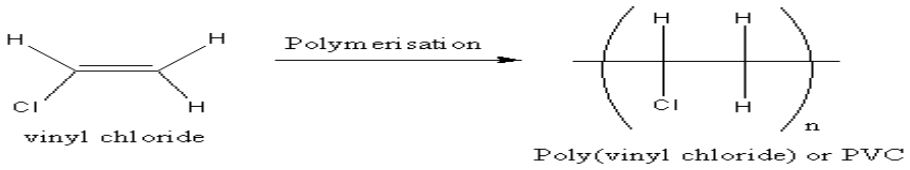
- PAN is soluble in DMF, Dimethyl sulphoxide, adiponitrile,
- Resistance to heat up to around 200c and exhibits very good mechanical properties.

Uses:

- It is used to produce PAN fibers.
- The copolymer of acrylonitrile with butadiene is a material of great industrial importance.

4.1.5 polyvinyl chloride (PVC)

Preparation: it is obtained by heating a water emulsion of vinyl chloride in presence of a small amount of benzoyl peroxide or hydrogen peroxide in an autoclave under pressure.



Properties:

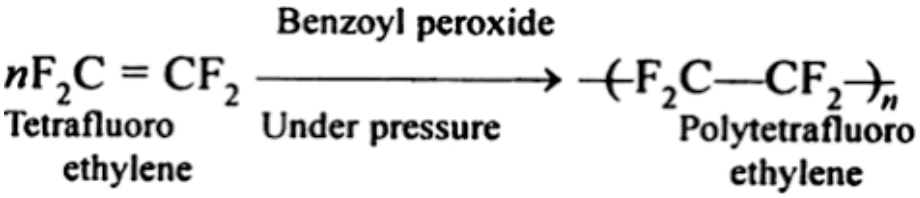
- ✓ PVC is colorless, odorless, non-inflammable chemically inert powder, but soluble in chlorinated hydrocarbons, such as ethyl chloride
- ✓ PVCis most synthetic plastics
- ✓ Greater stiffness and rigidity
- ✓ Uses:
- Making sheets
- Tyres, cycle, motorcycle mudguards

- Rain coats, table cloths, curtains, electrical cables

4.1.6, Polytetrafluoroethylene (TEFLON)

Preparation:

It is obtained by polymerization of water-emulsion of tetrafluoroethylene, under pressure in presence of benzoyl peroxide as catalyst.



Properties:

- High density, waxy touch, very low coefficient of friction,
- good electrical and mechanical properties.
- Extreme toughness, high softening point, very viscous, opaque mass.
-

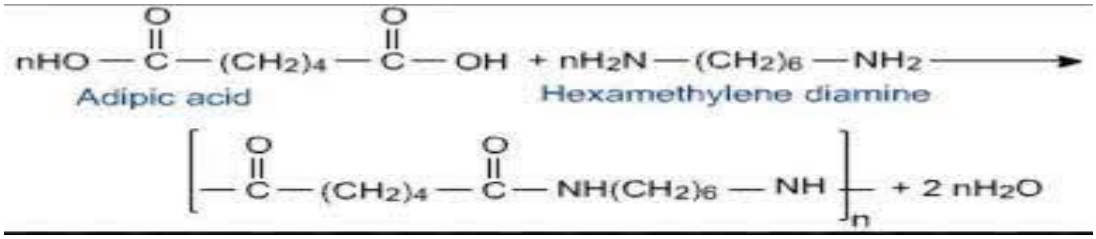
Uses:

- As insulating material and for making gaskets,
- packings, pump parts, tank linings, chemical carrying pipes, asbestos fibers and clothes.
- Non lubricating bearings and non-sticking stop cocks.

4.1.7 NYLON

Preparation:

Nylon 6 6 is obtained bt the polymerization of Adipic acid with hexamethylene diamine.



Properties:

- They are light, horny and high melting
- They are insoluble in common solvents
- They have good strength, absorb little moisture and trip dry in nature.
- Very flexible

Uses:

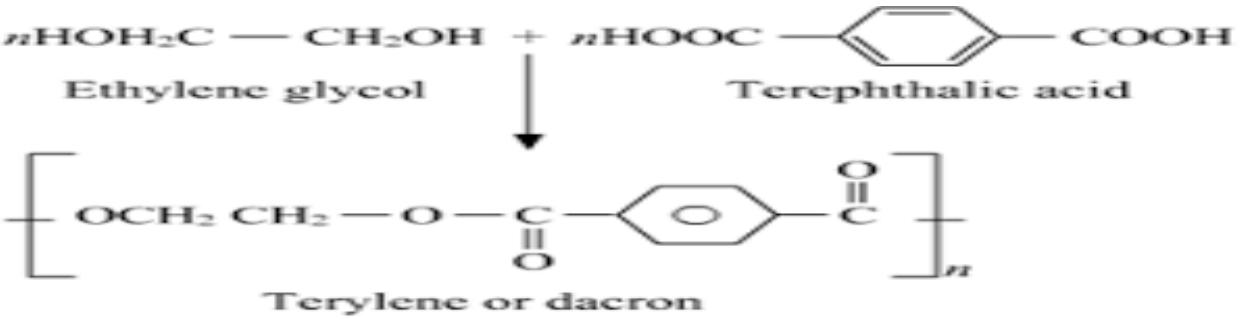
- It is used for fibers, making socks,

- ladies' shoes,
- under garments, dresses, carpets.

4.1. Polyester

Preparation:

Polyester resins are condensation products of dicarboxylic acid with dihydroxy alcohols. For example, terene is formed by condensation of ethylene glycol (a diol)and terephthalic acid(a saturated diacid).



Properties:

- Polyester is used to good forming material and is converted into commercial fibers.
- High stretch -resistance
- High crease and wrinke-resistance
- High resistant to mineral and organic acids, but is less resistant to alkalis.

Uses:

- It is mostly used for making synthetic fibers, like terylene, Dacron
- For blending with wool to provide better crease and wrinkle resistance
- As glass reinforcing material in safety helmets, aircrafts battery boxes, etc.

4.2 Thermosetting Plastics:

Thermosetting polymers(thermosets):Thermosets are those polymers, which during moulding (by heating)get hardened and once they have solidified i.e., they are permanent polymers.Such polymers during moulding acquire three-dimensional cross-linked structure,with strong covalent bonds.

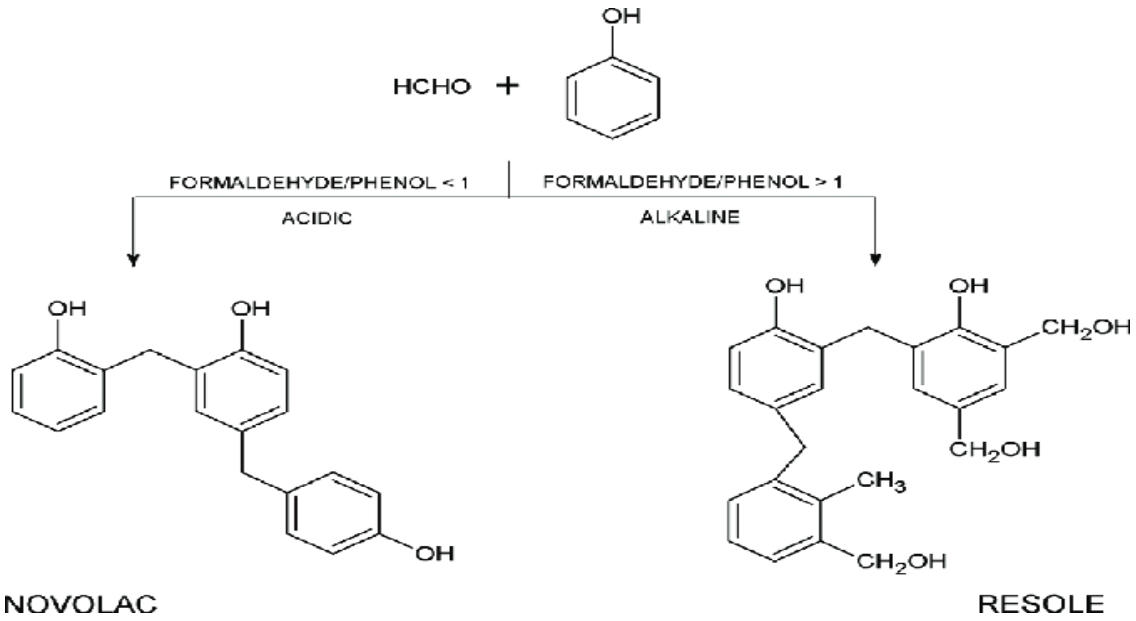
Thus,a thermosetting polymer once moulded cannot be reprocessed.

Eg: polystyrene (terylene), Bakelite, epoxy resin, melamine, urea formaldehyde etc.

4.2.1 Phenol formaldehyde resin

Phenol formaldehyde resins are formed by the condensation between phenol and formaldehyde.

The polycondensation reaction can be catalyzed either by acids and bases.



Uses:

- The Bakelite resins are usually compounded with fillers such as asbestos powder or sawdust and used for moulding electrical items, telephone instruments.
- The resols are used for making laminates, paper, fabric or asbestos cloth are impregnated with the resols.
- Many layers of the impregnated material are pressed together in a hydraulic press and heated to around 500 C.
- To form a single sheet of a greater thickness.

4.2.2 Epoxide resins:

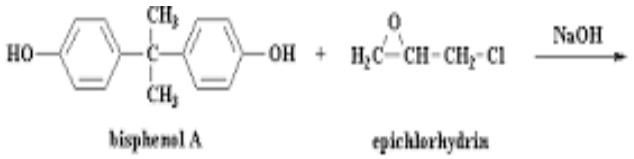
the epoxy polymers are basically polyethers.one type of epoxy polymer is prepared from epichlorohydrin and bisphenol-A.

The reaction is carried out with excess of epichlorohydrin

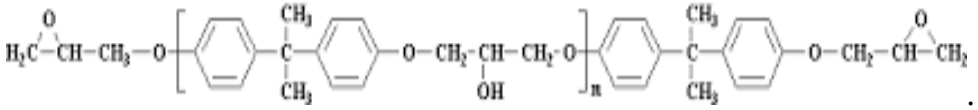
The epoxy resins obtained through these reactions will be either highly viscous liquids or solids with high melting points.

The epoxy resins can be further cured with substances such as amines,polysulfides and polyamides.

Preparation:



bisphenol A epichlorhydrin



Properties:

- Chemical resistant material
- Good adhesion
- Excellent structural adhesives.

Uses:

- It is used in industrial floorings, foams, potting materials for electrical insulations.,
- One constituent in many of the fiber-reinforced plastics (FRP)is a poxy polymer.

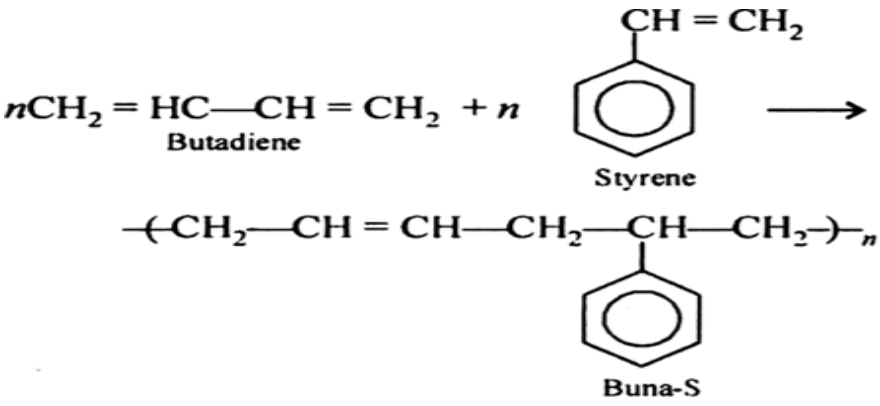
4.3 ELASTOMERS:

- Elastomer are high polymers, which have elastic properties in excess of 300%.
- An elastomer(rubber)is any vulcanisable man-made rubber-like polymer. when vulcanized into the rubbery products exhibiting good strength and elongation, polymers used as elastomers.
- An elastomer molecule is not straight chained Eg: polyethene, nylon etc., but in the case of coil, it can be stretched like a spring.

4.3.1 BUNA-S:

It is probably the most important type of synthetic rubber, which is produced by copolymerization of butadiene and styrene.

Preparation:



Properties:

- It possesses high abrasion-resistance
- High load bearing capacity and resilence.it gets oxidized in presence of ozone present in the atmosphere
- It swells in oils and solvents.
- It can be vulcanized in the same way as natural rubber by Sulphur or Sulphurmonochloride.

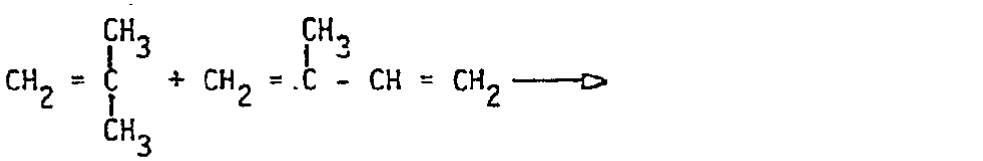
Uses:

- Mainly used in the manufacture of motor tyres.
- Floor tiles, shoe soles, foot wear components, wire and
- cable insulations carpet backing adhesions, tank linings etc.…

4.3.2 BUNA-N:

Is made by copolymerization of isobutene with small amounts (usually 1 to 5%) of isoprene.

Preparation:



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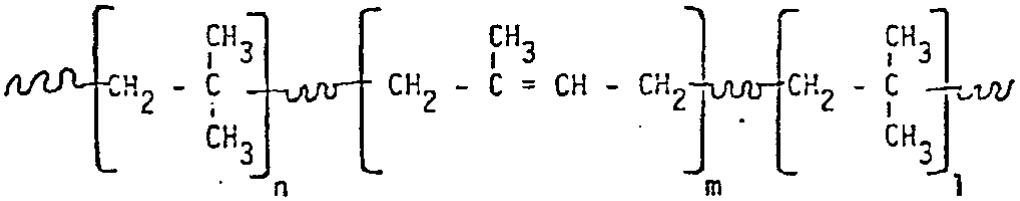


Properties:

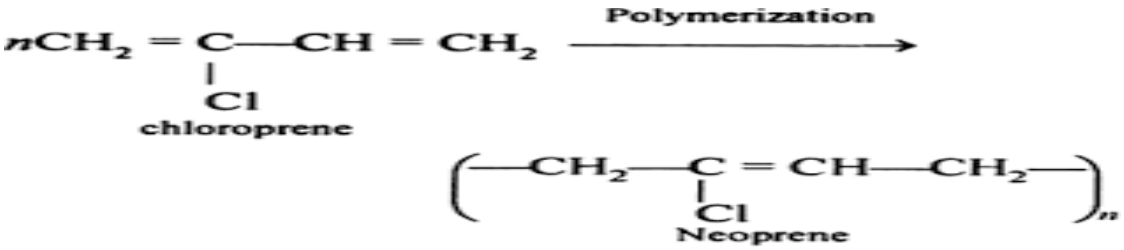
- Low permeability to air and other gases
- Excellent resistant to heat, abrasion, ageing, chemicals, polar solvents
- It is soluble in benzene.
- Good electrical insulating properties.

Uses:

- For making cycle, automobile tubes, automobile parts, hoses,
- conveyor belts for food and other materials,
- tank linings, insulation for high voltage wires and cables.

4.3.3NEOPRENE:

POLYCHLOPRENE IS OTHERWISE CALLED AS NEOPRENE.



Chloroprene is manufactured by the addition of hydrogen chloride to vinyl acetylene.
Vinyl acetylene is produced by the dimerization of acetylene.

The polychloroprene is synthesized by the emulsion technique.

It can be readily vulcanized with the help of zinc oxide or magnesium oxide.

Properties:

The vulcanized products are having excellent tensile strength.

Higher oil resistance

Uses:

- Coating to wires and cables
- Shoe soles
- Solid tyres
- Gloves and industrial hoses.

4.4 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

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. Further, 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 itsconductivity, e.g., pyrrole.

1. (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:p-Doping and n-Doping

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

3. (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.

Applications of conducting polymers:

Conducting polymers are widely used: 1. In rechargeable batteries. 2. In making analytical sensors for pH, O2,SO2, NH3, 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.

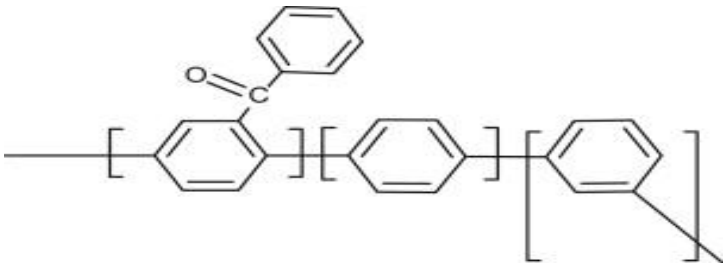
Examples:

Poly phenylene:

This polymer is composed entirely of aromatic rings forming the chain backbone.

The starting material is Para dibromo benzene

This compound when treated with activated copper powder at high temperature, yields Para phenylene as follows.



The polymer can be prepared by the cationic polymerization of benzene with aluminum trichloride and cupric chloride.

This polymer is very brittle and insoluble caused by the presence of aromatic ring chains linked together through p-positions.

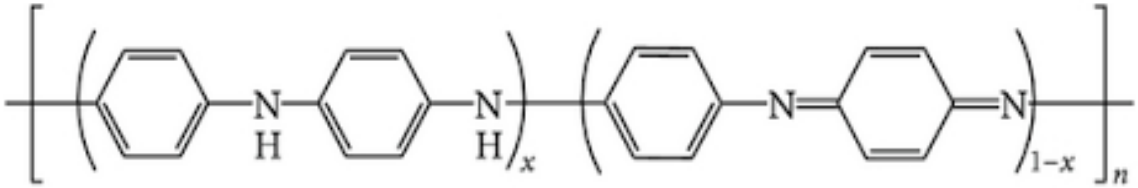
It can derive from the presence of resonance stabilized conjugated double bonds in the aromatic rings.

Polyaniline: it is aromatic conjugatedpolymer, synthesized by electrochemical oxidation of aniline using ammonium peroxodisulphate or potassium iodate as oxidizing agent.

Polyaniline has a unique structure consisting of an alternating arrangements of benzene rings and nitrogen atoms.

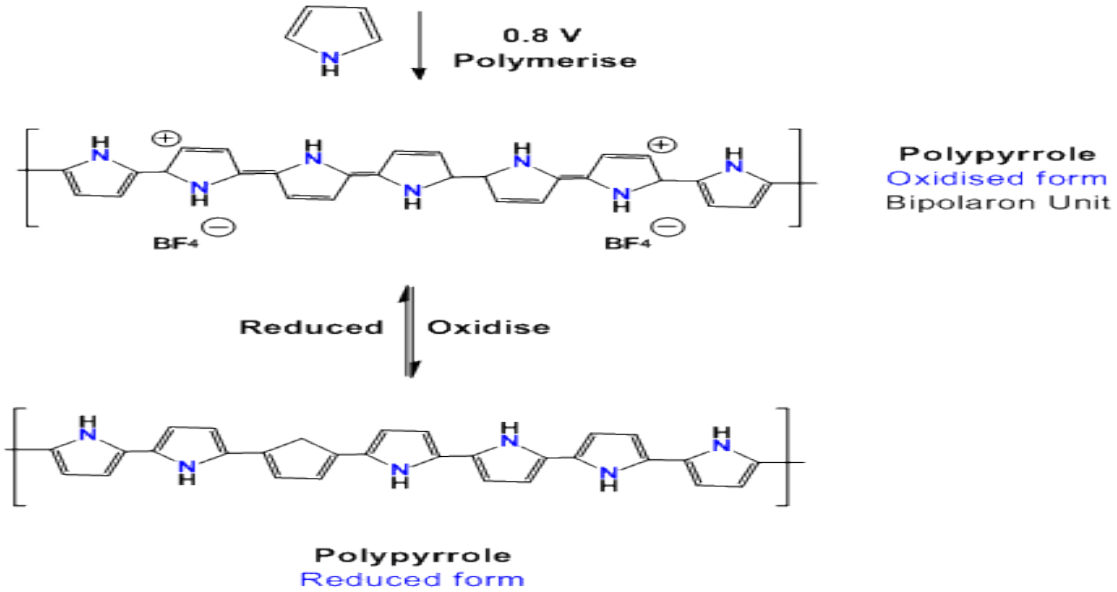
The nitrogen atoms exist either as an amine or imine.

Depending on the relative concentration of nitrogen, polyaniline exists in three different oxidation state.



Polypyrrole:

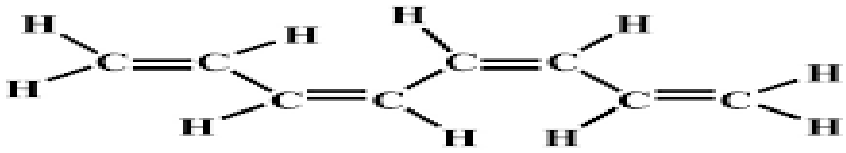
Polypyrrole is a type of organic polymer formed from by polymerization of pyrrole is an insulator but ii is oxidized derivatives are good conductors. The conductivity of the materials depends on the conditions and reagents used in the oxidation, conductivities range from 2 to 100 S/cm.



Polyacetylene (PA)

Polyacetylene is the simplest molecular framework possessing conjugated polymer.

It is also known as aniline black.it is produced from bulk powder, cast films and fibers.



Cis–Polyacetylene

Trans–Polyacetylene

Cis-polyacetylene	$\sigma = 1.7 \times 10^{-9}$ S cm^{-1}
Trans-polyacetylene	$\sigma = 4.4 \times 10^{-5}$ S cm^{-1}