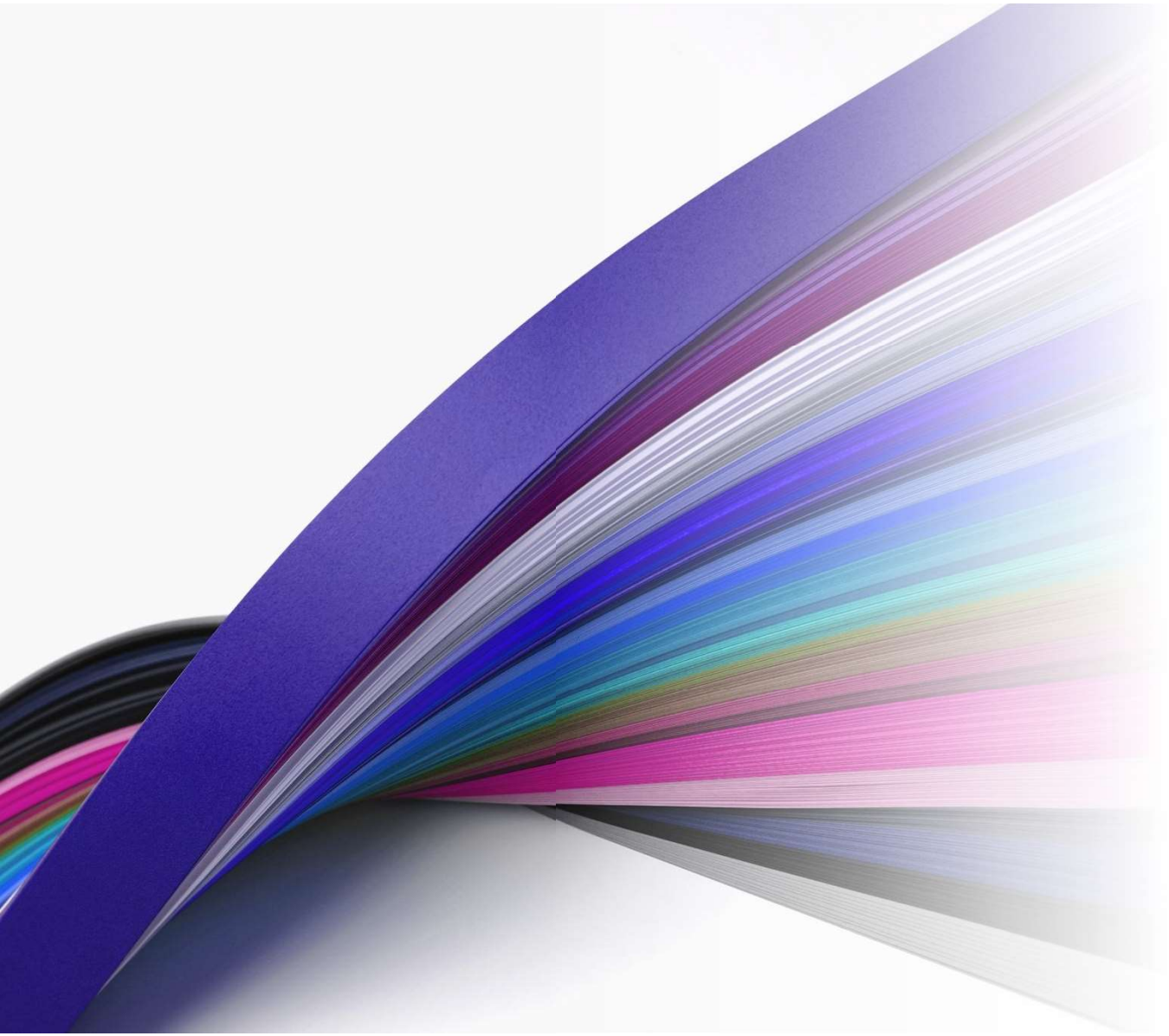


Inorganic Polymers

Contents

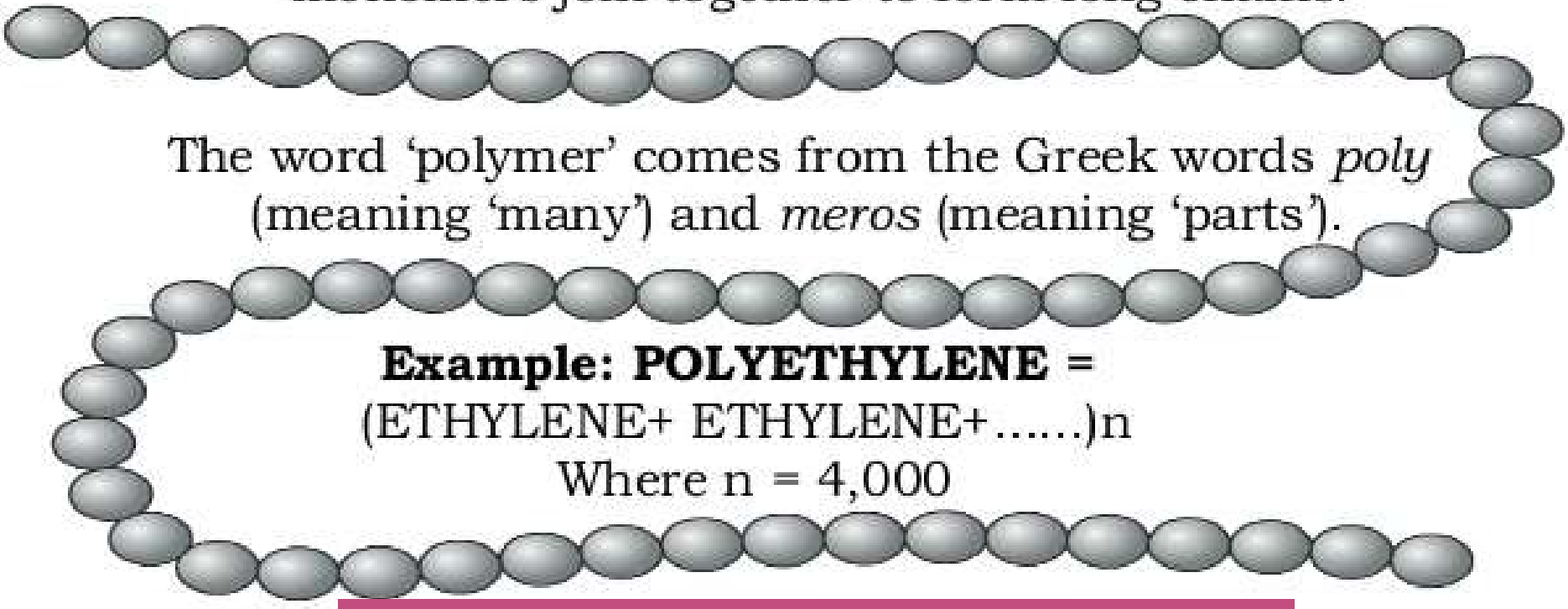
- What Are Polymers?
- Introduction
- Why Do We Need Inorganic Polymers?
- Classification Parameters

1. Classification On The Basis Of Connectivity
2. Classifications by dimensionality
3. Classification On The Basis Of Chemical Constituents

- Sources

Polymers

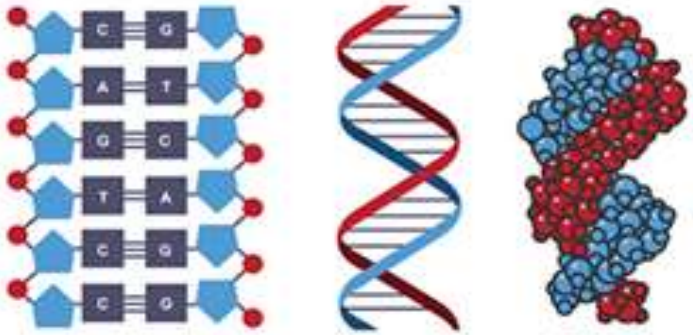
Polymers are very large molecules made when hundreds of monomers join together to form long chains.



The word 'polymer' comes from the Greek words *poly* (meaning 'many') and *meros* (meaning 'parts').

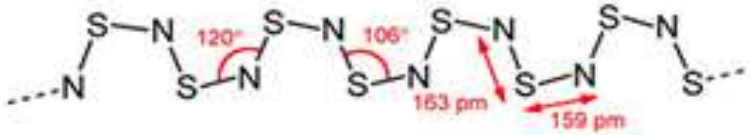
Example: POLYETHYLENE =
(ETHYLENE+ ETHYLENE+……)n
Where n = 4,000

DIFFERENT TYPES OF POLYMERS

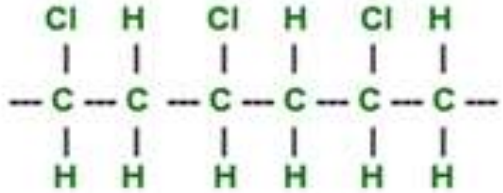


NATURAL POLYMERS

SYNTHETIC POLYMERS



INORGANIC POLYMERS



ORGANIC POLYMERS

Poly(ethene)

Polythene

- Waterproof
- Flexible
- Strong
- Low density
- Insulator

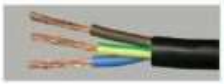
Poly(propene)

Polypropylene

- Cheap
- Strong
- Hard **or** flexible
- Shatterproof

Poly(chloroethene)

PVC



- Waterproof
- Tough
- Good insulator
- Hard **or** flexible forms

Poly(tetrafluoroethene)

Teflon

- Tough
- Slippery
- Non-stick
- Low reactivity

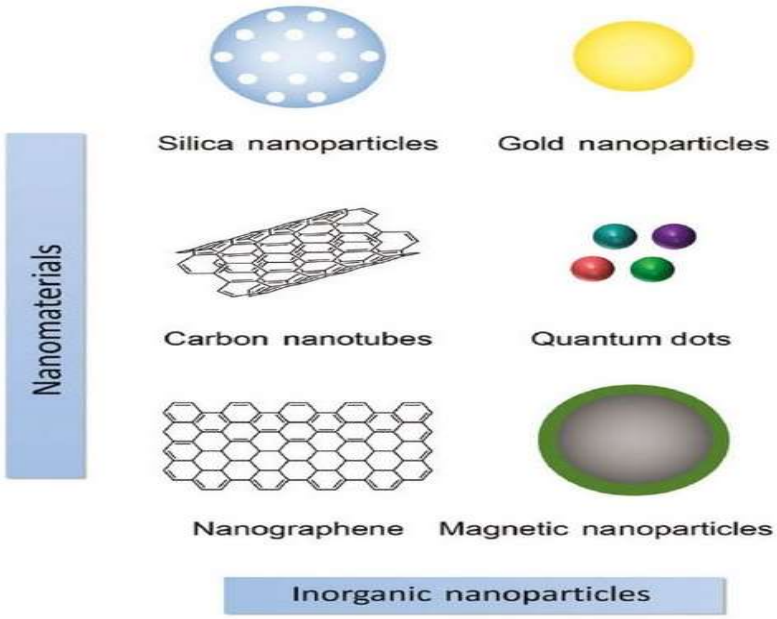
Introduction

- Polymer chemistry impinges on nearly every aspect of modern life, from electronics technology, to medicine, to the wide range of fibers, films, elastomers, and structural materials on which everyone depends.
- Most of these polymers are organic materials. By this we mean that their long polymeric backbones consist mainly of carbon atoms linked together with covalent bonds.
- Organic polymers are derived either from petroleum or from plants, animals, or microorganisms. Hence, they are generally accessible in large quantities and at nominal cost. It is difficult to imagine life without them.

Introduction Of Inorganic Polymers

- Inorganic polymers by looking its name one can say that they are nonorganic or non-carbon containing polymers. The most obvious definition for an inorganic polymer is a polymers with a skeletal structure that does not include carbon atoms in the backbone.
- Polymer that has inorganic repeating units in their main polymeric backbone are known as inorganic polymers.
- It is a giant 3D or 2D network structure made up by number of covalent bonds but with an absence or near-absence of hydrocarbon units in the main molecular backbone.

Polymer	Inorganic Component
Poly(ethylene oxide)	SiO_2
Polypropylene	TiO_2
	SiO_2
Polyimide	SiO_2
Polysulfone	TiO_2
Poly(vinyl-co-acetate)	SiO_2
Polyethylene-octene	SiO_2
Polyaniline	SiO_2
Poly(ethylene terephthalate)	ZnO
	SiO_2
Nafion	TiO_2
Unidentified [3]	Si
Polystyrene	CdS
Epoxy	TiO_2
	SiO_2



Comparison Between Organic Polymers And Inorganic Polymers

Points of Comparison	Organic Polymers	Inorganic Polymers
Definition	Organic polymers are materials that essentially contain carbon atoms in the backbone.	Inorganic polymers are polymers with a skeletal structure that does not include carbon atoms in their backbone.
Bonding	Have ionic and hydrocarbon bonds in their backbone along with some heteroatom such as oxygen, nitrogen and sulphur.	The backbones of organic polymers have carbon-carbon bonds along with heterochain of atoms such as oxygen, nitrogen and sulphur inserted along the backbone.
Solubility	Most organic polymers have carbon-carbon bonds between molecules and hence are insoluble in water, though they are soluble in other organic solvents.	Inorganic polymers are highly soluble in common organic solvents and water.

Comparison Between Organic Polymers And Inorganic Polymers

Points of Comparison	Organic Polymers	Inorganic Polymers
Electrical Conductivity	In most of the aqueous solutions, organic Polymers are typically poor conductors of electricity and heat.	Inorganic polymers in aqueous solutions are good conductors of electricity, this is because they have high ability to ionize and this makes them better conductors.
Flammability	Flammable.	Nonflammable
Melting and Boiling Points	The melting and boiling points of organic polymers is higher than that of inorganic polymers.	The melting and boiling points of inorganic polymers is lower than that of organic polymers.

Examples	Examples of organic polymers include low density polyethylene, high density polyethylene, polypropylene, polyvinyl chloride, polystyrene, nylon, Tefon and thermoplastic polyurethane.	Examples of inorganic polymers include silicone rubber (polydimethylsiloxane), polysiloxanes, polyphosphazenes, and polysilanes.
Uses	Polystyrene resins are used in the production of home electronics and appliances. Nylon-6 is used in textile and plastic industries. Polyethylene terephthalate are in the manufacture of popular PET bottles. Others such as neoprene are used in shoe soles and wet suits. Polyvinyl chloride in pipes and Teflon in non-stick pans.	Used in petrochemical industries.Silicone rubber is used in construction for window and door seals. Also silicon rubber is used in wire and cable jacketing and in electrical safety stinger covers. Polydimethylsiloxane are widely used as a versatile ingredient in many skin care and beauty products because of its ability to serve as an anti-foaming agent, skin protectant and conditioner.

Why Do We Need Inorganic Polymers Over Organic Polymers?

- Many organic backbone polymers react with oxygen or ozone over a long period of time and lose their advantageous properties.
- Most organic polymers burn, often with the release of toxic smoke.
- Many organic polymers degrade when exposed to ultraviolet or gamma radiation.
- Organic polymers sometimes soften at unacceptably low temperatures, or they swell or dissolve in organic solvents, oils, or hydraulic fluids.
- Now in case of Inorganic polymers; inorganic elements can have different valencies than carbon, and this means that the number of side groups attached to a backbone may be different from the situation in an organic polymer. This will affect the flexibility of the macromolecule, its ability to react with chemical reagents, its stability at high temperatures, and its interactions with solvents and with other polymer molecules.
- The bonds formed between inorganic elements are often longer, stronger, and more resistant to free radical cleavage reactions than are bonds formed by carbon.

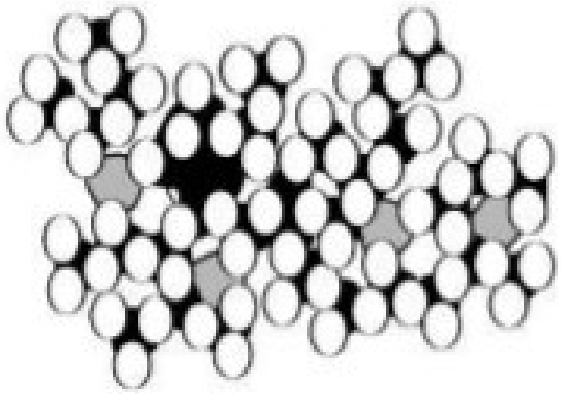
Classification On The Basis Of Chemical Constituents

- According to this classification method inorganic polymers are classified on the basis of parameters as following:

1. wholly inorganic polymers
2. inorganic-organic polymers
3. organometallic polymers
4. hybrid organic-inorganic polymers

wholly inorganic polymers

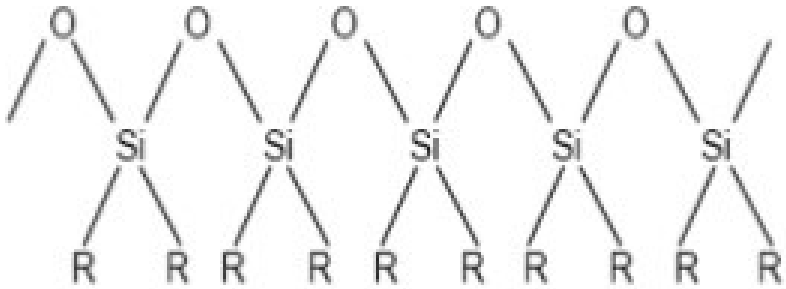
- Inorganic polymers in this class constitute the major components of soil, mountains and sand, and they are also employed as abrasives and cutting materials (diamond, silicon carbide (carborundum), fibres (fibrous glass, asbestos, boron fibres), coatings, flame retardants, building and construction materials (window glass, stone, Portland cement, brick and tiles), and lubricants and catalysts (zinc oxide, nickel oxide, carbon black, silica gel, aluminium silicate, and clays).

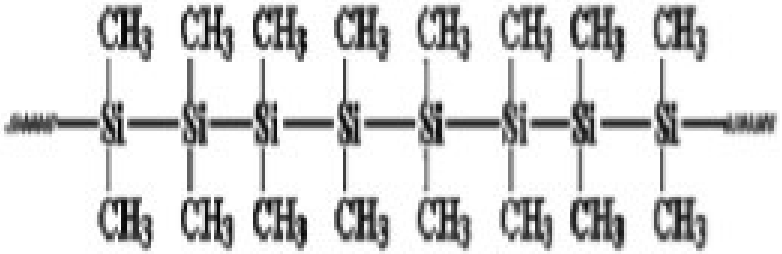


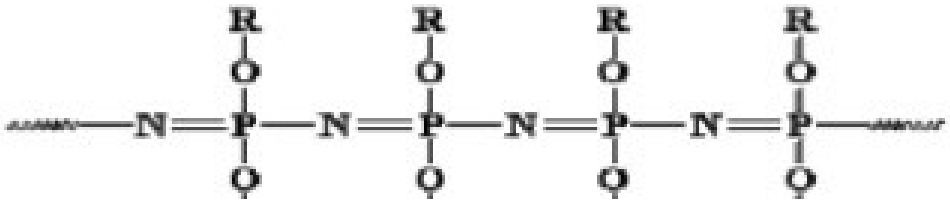
Structure of a typical silicon dioxide intensive glass

Inorganic-organic Polymers

- Inorganic polymers containing organic portions attached to inorganic elements in their backbone. The area of inorganic-organic polymers is very extensive. Some examples of this class are: polysilanes, polysiloxanes, polyphosphazenes.







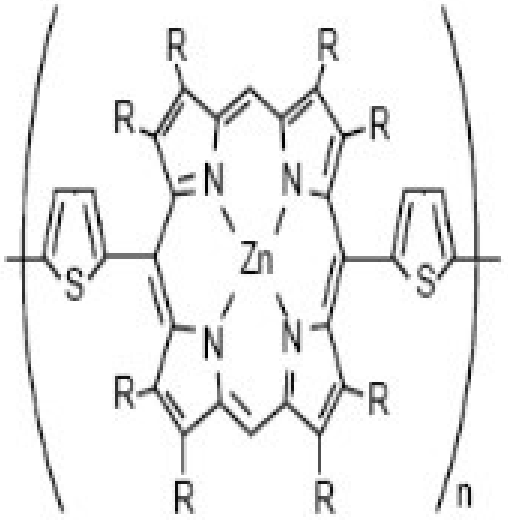
Organometallic Polymers

- Organometallic polymers are made of over 40 elements including main group of metals (si or ge), transition metals or rare earth elements in addition to the 10 elements (C, H, N, O, B, P, halides) which is found in organic polymers. The variations of organometallic polymers seem endless.
- Organometallic polymers are new materials which combine the low density and structural variations and functional group varieties of organic materials with electrical conductivity and the high temperature stability features of inorganic compounds.

Different structures found in organometallic polymers

Hybrid organic-inorganic polymers

- Hybrid organic-inorganic networks, prepared via sol-gel process, are multi-functional materials offering a wide range of interesting properties. Since there are countless different combinations of the organic and inorganic moieties, a large number of applications are possible by incorporation of inorganic building blocks such as silica networks, porous materials and metals.



Π-conjugated polymers prepared via