

## Chapter 1 : Polymer - Wikipedia

*If you're after basic information on plastic materials, this is the place to find it. Here you'll learn the definition and properties of polymers, another name for plastics.*

Certain polymers, such as proteins, cellulose, and silk, are found in nature, while many others, including polystyrene, polyethylene, and nylon, are produced only by synthetic routes. In some cases, naturally occurring polymers can also be produced synthetically. An important example is natural Hevea rubber, known as polyisoprene in its synthetic form. Polymers that are capable of high extension under ambient conditions find important applications as elastomers. In addition to natural rubber, there are several important synthetic elastomers including nitrile and butyl rubber. Other polymers may have characteristics that enable their fabrication into long fibers suitable for textile applications. The synthetic fibers, principally nylon and polyester, are good substitutes for naturally occurring fibers such as cotton, wool, and silk. In contrast to the usage of the word polymer, those commercial materials other than elastomers and fibers that are derived from synthetic polymers are called plastics. A typical commercial plastic resin may contain two or more polymers in addition to various additives and fillers. These are added to improve a particular property such as processability, thermal or environmental stability, or mechanical properties. The birth of polymer science may be traced back to the mid-nineteenth century. In the s, Charles Goodyear developed the vulcanization process that transformed the sticky latex of natural rubber into a useful elastomer for tire use. In , Christian F. This was used in the s as the first man-made thermoplastic, celluloid. Glyptal unsaturated-polyester resin was developed as a protective coating resin by General Electric in . By , Dow had produced polystyrene in commercial scale for the first time and, in , polyethylene low-density was made by scientists at ICI in England. Efforts to develop new polymeric materials, particularly synthetic rubber, were intensified during World War II when many naturally occurring materials such as Hevea rubber were in short supply. In the s, Karl Ziegler and Giulio Natta independently developed a family of stereospecific transition-metal catalysts that made possible the commercialization of polypropylene as a major commodity plastic. The s and s witnessed the development of a number of high-performance engineering plastics polymers that could compete favorably with more traditional materials, such as metals, for automotive and aerospace applications. These included polycarbonate, poly phenylene oxide , polysulfones, polyimides, aromatic polyamides such as Kevlar, and other high-temperature rigid-chain polymers. More recently, specialty polymers with electrically conducting, photoconducting, and liquid-crystalline properties have appeared for a variety of applications. Today, polymeric materials are used in nearly all areas of daily life and their production and fabrication are major worldwide industries. In , the total U. Among plastics, the largest shares of the total production in were the polyethylenes, followed by polypropylene, poly vinyl chloride PVC , and polystyrene.

**Chapter 2 : Polymer Science and Technology: Plastics, Rubbers, Blends and Composites, Third Edition**

1. *Types (classification) of polymers and polymerization* – Based on composition and structure: condensation and addition - Condensation polymers: polymers formed from polyfunctional monomers by the various.

Carbon nanotubes, gold particles and synthetic polymers are used for this purpose. This immobilization has been achieved predominantly by adsorption or by chemical binding and to a lesser extent by incorporating these objects as guests in host matrices. In the guest host systems, an ideal method for the immobilization of biological objects and their integration into hierarchical architectures should be structured on a nanoscale to facilitate the interactions of biological nano-objects with their environment. Due to the large number of natural or synthetic polymers available and the advanced techniques developed to process such systems to nanofibres, rods, tubes etc. To come down in diameter into the range of several hundreds of nanometers or even down to a few nanometers, Electrospinning is today still the leading polymer processing technique available. The electric charges, which are accumulated on the surface of the droplet, cause droplet deformation along the field direction, even though the surface tension counteracts droplet evolution. In supercritical electric fields, the field strength overbears the surface tension and a fluid jet emanates from the droplet tip. The jet is accelerated towards the counter electrode. During this transport phase, the jet is subjected to strong electrically driven circular bending motions that cause a strong elongation and thinning of the jet, a solvent evaporation until, finally, the solid nanofibre is deposited on the counter electrode. Bio-hybrid polymer nanotubes by wetting[ edit ] Electro spinning, co-electrospinning, and the template methods based on nanofibres yield nano-objects which are, in principle, infinitively long. For a broad range of applications including catalysis, tissue engineering, and surface modification of implants this infinite length is an advantage. But in some applications like inhalation therapy or systemic drug delivery, a well-defined length is required. The template method to be described in the following has the advantage such that it allows the preparation of nanotubes and nanorods with very high precision. The method is based on the use of well defined porous templates, such as porous aluminum or silicon. The basic concept of this method is to exploit wetting processes. A polymer melt or solution is brought into contact with the pores located in materials characterized by high energy surfaces such as aluminum or silicon. Wetting sets in and covers the walls of the pores with a thin film with a thickness of the order of a few tens of nanometers. Gravity does not play a role, as it is obvious from the fact that wetting takes place independent of the orientation of the pores relative to the direction of gravity. The exact process is still not understood theoretically in detail but its known from experiments that low molar mass systems tend to fill the pores completely, whereas polymers of sufficient chain length just cover the walls. This process happens typically within a minute for temperatures about 50 K above the melting temperature or glass transition temperature, even for highly viscous polymers, such as, for instance, polytetrafluoroethylene , and this holds even for pores with an aspect ratio as large as 10, The complete filling, on the other hand, takes days. The diameter of the nanotubes, the distribution of the diameter, the homogeneity along the tubes, and the lengths can be controlled. Applications[ edit ] The nanofibres, hollow nanofibres, core-shell nanofibres, and nanorods or nanotubes produced have a great potential for a broad range of applications including homogeneous and heterogeneous catalysis, sensorics, filter applications, and optoelectronics. Here we will just consider a limited set of applications related to life science. Tissue engineering[ edit ] This is mainly concerned with the replacement of tissues which have been destroyed by sickness or accidents or other artificial means. The examples are skin, bone, cartilage, blood vessels and may be even organs. This technique involves providing a scaffold on which cells are added and the scaffold should provide favorable conditions for the growth of the same. Nanofibres have been found to provide very good conditions for the growth of such cells, one of the reasons being that fibrillar structures can be found on many tissues which allow the cells to attach strongly to the fibers and grow along them as shown. Nanoparticles such as graphene, [2] carbon nanotubes, molybdenum disulfide and tungsten disulfide are being used as reinforcing agents to fabricate mechanically strong biodegradable polymeric nanocomposites for bone tissue engineering applications. The results suggest that mechanical reinforcement is dependent on the nanostructure morphology, defects,

dispersion of nanomaterials in the polymer matrix, and the cross-linking density of the polymer. In general, two-dimensional nanostructures can reinforce the polymer better than one-dimensional nanostructures, and inorganic nanomaterials are better reinforcing agents than carbon based nanomaterials. Delivery from compartmented nanotubes[ edit ] Nano tubes are also used for carrying drugs in general therapy and in tumor therapy in particular. The role of them is to protect the drugs from destruction in blood stream, to control the delivery with a well-defined release kinetics, and in ideal cases, to provide vector-targeting properties or release mechanism by external or internal stimuli. Rod or tube-like, rather than nearly spherical, nanocarriers may offer additional advantages in terms of drug delivery systems. Nanotubes prepared with a responsive polymer attached to the tube opening allow the control of access to and release from the tube. Furthermore, nanotubes can also be prepared showing a gradient in its chemical composition along the length of the tube. Compartmented drug release systems were prepared based on nanotubes or nanofibres. Nanotubes and nanofibres, for instance, which contained fluorescent albumin with dog-fluorescein isothiocyanate were prepared as a model drug, as well as super paramagnetic nanoparticles composed of iron oxide or nickel ferrite. The presence of the magnetic nanoparticles allowed, first of all, the guiding of the nanotubes to specific locations in the body by external magnetic fields. Super paramagnetic particles are known to display strong interactions with external magnetic fields leading to large saturation magnetizations. In addition, by using periodically varying magnetic fields, the nanoparticles were heated up to provide, thus, a trigger for drug release. The presence of the model drug was established by fluorescence spectroscopy and the same holds for the analysis of the model drug released from the nanotubes. Immobilization of proteins[ edit ] Core shell fibers of nano particles with fluid cores and solid shells can be used to entrap biological objects such as proteins, viruses or bacteria in conditions which do not affect their functions. This effect can be used among others for biosensor applications. For example, Green Fluorescent Protein is immobilized in nanostructured fibres providing large surface areas and short distances for the analyte to approach the sensor protein. With respect to using such fibers for sensor applications fluorescence of the core shell fibers was found to decay rapidly as the fibers were immersed into a solution containing urea: This simple experiment reveals that core-shell fibers are promising objects for preparing biosensors based on biological objects. Polymer nanostructured fibers, core-shell fibers, hollow fibers, and nanorods and nanotubes provide a platform for a broad range of applications both in material science as well as in life science. Biological objects of different complexity and synthetic objects carrying specific functions can be incorporated into such nanostructured polymer systems while keeping their specific functions vital. Biosensors, tissue engineering, drug delivery, or enzymatic catalysis is just a few of the possible examples. The incorporation of viruses and bacteria all the way up to microorganism should not really pose a problem and the applications coming from such biohybrid systems should be tremendous. The problem can be partially solved by replacing Cb with silica , because it enables the production of "green" tires that display both improved wet grip properties as well as a smaller rolling resistance. So in order to increase the compatibility among the silica fillers and the polymer matrix, the silica is usually functionalized with coupling agents, which gives the possibility of tuning the filler-polymer interactions and thus producing nanocomposites of specific properties. Size and pressure effects on nanopolymers[ edit ] The size- and pressure- dependent glass transition temperatures of free-standing films or supported films having weak interactions with substrates decreases with decreasing of pressure and size. However, the glass transition temperature of supported films having strong interaction with substrates increases of pressure and the decrease of size. For a nanoparticle,  $D$  has a usual meaning of diameter, for a nanowire,  $D$  is taken as its diameter, and for a thin film,  $D$  denotes its thickness.  $D_0$  denotes a critical diameter at which all molecules of a low-dimensional glass are located on its surface. In the case of polymer nanocomposites we can use the properties of disordered systems. Here recent developments in the field of polymer nano-composites and some of their applications have been reviewed. Though there is much use in this field, there are many limitations also. For example, in the release of drugs using nanofibres, cannot be controlled independently and a burst release is usually the case, whereas a more linear release is required. Let us now consider future aspects in this field. There is a possibility of building ordered arrays of nanoparticles in the polymer matrix. A number of possibilities also exist to manufacture the nanocomposite circuit boards. An

even more attractive method exists to use polymer nanocomposites for neural networks applications. Another promising area of development is optoelectronics and optical computing. The single domain nature and super paramagnetic behavior of nanoparticles containing ferromagnetic metals could be possibly used for magneto-optical storage media manufacturing.

**Chapter 3 : Introduction to Polymer Science | Classification of Polymers | InformIT**

*The book is divided into four chapters. The first chapter covers polymer fundamentals. This includes a brief discussion of the historical development of polymers, basic definitions and concepts, and an overview of the basis for the various classifications of polymers.*

The simplest definition of a polymer is a useful chemical made of many repeating units. A polymer can be a three dimensional network think of the repeating units linked together left and right, front and back, up and down or two-dimensional network think of the repeating units linked together left, right, up, and down in a sheet or a one-dimensional network think of the repeating units linked left and right in a chain. Repeating units are often made of carbon and hydrogen and sometimes oxygen, nitrogen, sulfur, chlorine, fluorine, phosphorous, and silicon. Linking countless strips of construction paper together to make paper garlands or hooking together hundreds of paper clips to form chains, or stringing beads helps visualize polymers. Polymers occur in nature and can be made to serve specific needs. Manufactured polymers can be three-dimensional networks that do not melt once formed. Epoxy resins used in two-part adhesives are thermoset plastics. Manufactured polymers can also be one-dimensional chains that can be melted. Plastic bottles, films, cups, and fibers are thermoplastic plastics. Polymers abound in nature. Spider silk, hair, and horn are protein polymers. Starch can be a polymer as is cellulose in wood. Rubber tree latex and cellulose have been used as raw material to make manufactured polymeric rubber and plastics. The first synthetic manufactured plastic was Bakelite, created in for telephone casing and electrical components. The first manufactured polymeric fiber was Rayon, from cellulose, in Nylon was invented in while pursuing a synthetic spider silk. The Structure of Polymers Many common classes of polymers are composed of hydrocarbons, compounds of carbon and hydrogen. These polymers are specifically made of carbon atoms bonded together, one to the next, into long chains that are called the backbone of the polymer. Because of the nature of carbon, one or more other atoms can be attached to each carbon atom in the backbone. There are polymers that contain only carbon and hydrogen atoms. Polyethylene, polypropylene, polybutylene, polystyrene and polymethylpentene are examples of these. Polyvinyl chloride PVC has chlorine attached to the all-carbon backbone. Teflon has fluorine attached to the all-carbon backbone. Other common manufactured polymers have backbones that include elements other than carbon. Nylons contain nitrogen atoms in the repeat unit backbone. Polyesters and polycarbonates contain oxygen in the backbone. There are also some polymers that, instead of having a carbon backbone, have a silicon or phosphorous backbone. These are considered inorganic polymers. Molecular Arrangement of Polymers Think of how spaghetti noodles look on a plate. These are similar to how linear polymers can be arranged if they lack specific order, or are amorphous. Controlling the polymerization process and quenching molten polymers can result in amorphous organization. An amorphous arrangement of molecules has no long-range order or form in which the polymer chains arrange themselves. Amorphous polymers are generally transparent. This is an important characteristic for many applications such as food wrap, plastic windows, headlight lenses and contact lenses. Obviously not all polymers are transparent. The polymer chains in objects that are translucent and opaque may be in a crystalline arrangement. By definition, a crystalline arrangement has atoms, ions, or in this case, molecules arranged in distinct patterns. You generally think of crystalline structures in table salt and gemstones, but they can occur in plastics. Just as quenching can produce amorphous arrangements, processing can control the degree of crystallinity for those polymers that are able to crystallize. Some polymers are designed to never be able to crystallize. Others are designed to be able to be crystallized. The higher the degree of crystallinity, generally, the less light can pass through the polymer. Therefore, the degree of translucence or opacity of the polymer can be directly affected by its crystallinity. Crystallinity creates benefits in strength, stiffness, chemical resistance, and stability. Scientists and engineers are always producing more useful materials by manipulating the molecular structure that affects the final polymer produced. Manufacturers and processors introduce various fillers, reinforcements and additives into the base polymers, expanding product possibilities. Characteristics of Polymers The majority of manufactured polymers are thermoplastic, meaning that once the

polymer is formed it can be heated and reformed over and over again. This property allows for easy processing and facilitates recycling. The other group, the thermosets, cannot be remelted. Once these polymers are formed, reheating will cause the material to ultimately degrade, but not melt. Every polymer has very distinct characteristics, but most polymers have the following general attributes. Polymers can be very resistant to chemicals. Consider all the cleaning fluids in your home that are packaged in plastic. Reading the warning labels that describe what happens when the chemical comes in contact with skin or eyes or is ingested will emphasize the need for chemical resistance in the plastic packaging. While solvents easily dissolve some plastics, other plastics provide safe, non-breakable packages for aggressive solvents. Polymers can be both thermal and electrical insulators. A walk through your house will reinforce this concept, as you consider all the appliances, cords, electrical outlets and wiring that are made or covered with polymeric materials. Thermal resistance is evident in the kitchen with pot and pan handles made of polymers, the coffee pot handles, the foam core of refrigerators and freezers, insulated cups, coolers, and microwave cookware. The thermal underwear that many skiers wear is made of polypropylene and the fiberfill in winter jackets is acrylic and polyester. Generally, polymers are very light in weight with significant degrees of strength. Consider the range of applications, from toys to the frame structure of space stations, or from delicate nylon fiber in pantyhose to Kevlar, which is used in bulletproof vests. Some polymers float in water while others sink. But, compared to the density of stone, concrete, steel, copper, or aluminum, all plastics are lightweight materials. Polymers can be processed in various ways. Extrusion produces thin fibers or heavy pipes or films or food bottles. Injection molding can produce very intricate parts or large car body panels. Plastics can be molded into drums or be mixed with solvents to become adhesives or paints. Elastomers and some plastics stretch and are very flexible. Some plastics are stretched in processing to hold their shape, such as soft drink bottles. Polymers are materials with a seemingly limitless range of characteristics and colors. Polymers have many inherent properties that can be further enhanced by a wide range of additives to broaden their uses and applications. Polymers can be made to mimic cotton, silk, and wool fibers; porcelain and marble; and aluminum and zinc. Polymers can also make possible products that do not readily come from the natural world, such as clear sheets and flexible films. Polymers are usually made of petroleum, but not always. Many polymers are made of repeat units derived from natural gas or coal or crude oil. But building block repeat units can sometimes be made from renewable materials such as polylactic acid from corn or cellulose from cotton linters. Some plastics have always been made from renewable materials such as cellulose acetate used for screwdriver handles and gift ribbon. When the building blocks can be made more economically from renewable materials than from fossil fuels, either old plastics find new raw materials or new plastics are introduced.

**Chapter 4 : Polymers and plastics: a chemical introduction**

*POLYMER SCIENCE FUNDAMENTALS OF POLYMER SCIENCE Basic Concepts Prof. Premamoy Ghosh Polymer Study Centre "Arghya" 3, kabi Mohitlal Road.*

Haltu, Kolkata- Polymers, as a class of materials with potential for use as rubbers, resins, plastics and composites, and as adhesives, laminates and coatings came nearly in the end of the chain of discoveries and developments of materials. Unfolding of the science of polymers and polymer based materials really had its beginning and headway in the second and third decade of the twentieth century. Though introduced very late in the chain of materials, polymers occupy a major place and pivotal position in our materials map today. In application prospects and performance characteristics and in property range and diversity, they offer novelty and versatility that can hardly be matched by any other kind of materials. Polymers have gone deep, and far and wide in moulding the present day human civilization and culture. Even though scientists, particularly the chemists used to talk about polymers earlier to the early twentieth century, there remained a lot of confusion over the basic understanding of the structures of polymer molecules. It was a common experience for chemists working with polymers that most such materials were very viscous and tacky under melt or solution conditions. One could readily spread the melt or solution into thin films or draw them into fine filaments. In solution, they were recognized more as colloids or associated molecules. Attempts to find their molecular weights from dilute solutions in suitable solvents by cryoscopy often produced irreproducible, doubtful and uncertain and sometimes very high values. For natural rubber, rayon and cellulose derivatives, molecular weights ranging 45, 50, or even higher were measured. Such high molecular weight values implied that the relevant polymer molecules were really very large; but this view point was not favoured or accepted in view of a total lack of structural concept about such large or big molecules. The chemists continued to favour the concept of large associations of much smaller molecules of short chain or cyclic structures. A state of growing dilemma and confusion imparted fresh impetus to the thinking about the size, shape, complexity, and behavioral patterns of the molecular systems called polymers. Long Chain Structure and Macromolecular Concept The realization of the long chain molecular or the macromolecular concept of polymer molecular systems in the s proved to be a vital turning point. Accumulated confused ideas and uncertainties of the earlier decades became meaningful and they were soon translated into practice through production of a large variety of hitherto unknown structures by polymerization and copolymerization of a host of olefinic, diolefinic and vinylic compounds and combinations thereof and by polycondensation reactions between a large variety of bifunctional or polyfunctional compounds bearing well characterizable chemical functional groups. The macromolecular or chain molecular concept found wide acceptance and appreciation soon after it was propounded by Staudinger in He advanced long chain structural formulas for natural rubber, cellulose such as cellulose nitrate, and polystyrene. Long sequences of simple chemical units interlinked with covalent bonds came into recognition as the basic structural feature for all polymer molecules. Staudinger was not initially certain about the nature or identity of the terminal points or end groups of the long chain polymer molecules. He was initially of the view that there was no need to saturate the terminal valences and suggested that no end groups were needed or necessary. Development and elucidation of the chain reaction theory of vinyl and related polymerization by Flory and others, however, clearly established that polymer materials consisted of long chain molecules with well characterizable end groups. One more distinctive feature of the same or the following decade is the pioneering work of Carothers in the area of polycondensation and towards the first rational synthesis of linear macromolecules, viz. A stage was soon reached by the mid 20th century, when the prospect of attaining any conceivable material property of structural importance through polymerization, copolymerization or polycondensation and through physical and chemical modifications covering changes in or incorporation of new functional groups, compounding and reinforcements, making polymer blends and alloys, irradiation, and thermo mechanical treatments looked very bright and within our competence. By then, we had actually reached the era of tailor-made polymers in a comprehensive sense. Structural Features of a Polymer or Macromolecule The word polymer literally means



**Chapter 5 : Polymer blend - Wikipedia**

Page 1 POLYMER SCIENCE FUNDAMENTALS OF POLYMER SCIENCE Basic Concepts Prof. Premamoy Ghosh  
Polymer Study Centre "Arghya" 3, kabi Mohitlal Road P.P. Haltu, Kolkata- () CONTENTS Introduction and Historical  
Perspective Long Chain Structure and Macromolecular Concept Structural Features of a Polymer or Macromolecule  
Length to Diameter Ratio Polymer Classifications Structure.

Polymer classes Polymers are of two types: Natural polymeric materials such as shellac , amber , wool , silk and natural rubber have been used for centuries. A variety of other natural polymers exist, such as cellulose , which is the main constituent of wood and paper. The list of synthetic polymers , roughly in order of worldwide demand, includes polyethylene , polypropylene , polystyrene , polyvinyl chloride , synthetic rubber , phenol formaldehyde resin or Bakelite , neoprene , nylon , polyacrylonitrile , PVB , silicone , and many more. More than million tons of these polymers are made every year However, other structures do exist; for example, elements such as silicon form familiar materials such as silicones, examples being Silly Putty and waterproof plumbing sealant. Oxygen is also commonly present in polymer backbones, such as those of polyethylene glycol , polysaccharides in glycosidic bonds , and DNA in phosphodiester bonds. Polymerization The repeating unit of the polymer polypropylene Polymerization is the process of combining many small molecules known as monomers into a covalently bonded chain or network. During the polymerization process, some chemical groups may be lost from each monomer. This is the case, for example, in the polymerization of PET polyester. The distinct piece of each monomer that is incorporated into the polymer is known as a repeat unit or monomer residue. Laboratory synthetic methods are generally divided into two categories, step-growth polymerization and chain-growth polymerization. However, some newer methods such as plasma polymerization do not fit neatly into either category. Synthetic polymerization reactions may be carried out with or without a catalyst. Laboratory synthesis of biopolymers, especially of proteins , is an area of intensive research. Biopolymer Microstructure of part of a DNA double helix biopolymer There are three main classes of biopolymers: In living cells, they may be synthesized by enzyme-mediated processes, such as the formation of DNA catalyzed by DNA polymerase. The synthesis of proteins involves multiple enzyme-mediated processes to transcribe genetic information from the DNA to RNA and subsequently translate that information to synthesize the specified protein from amino acids. The protein may be modified further following translation in order to provide appropriate structure and functioning. There are other biopolymers such as rubber , suberin , melanin and lignin. Modification of natural polymers[ edit ] Naturally occurring polymers such as cotton, starch and rubber were familiar materials for years before synthetic polymers such as polyethene and perspex appeared on the market. Many commercially important polymers are synthesized by chemical modification of naturally occurring polymers. Prominent examples include the reaction of nitric acid and cellulose to form nitrocellulose and the formation of vulcanized rubber by heating natural rubber in the presence of sulfur. Ways in which polymers can be modified include oxidation , cross-linking and endcapping. Especially in the production of polymers the gas separation by membranes has acquired increasing importance in the petrochemical industry and is now a relatively well-established unit operation. The process of polymer degassing is necessary to suit polymer for extrusion and pelletizing, increasing safety, environmental, and product quality aspects. Nitrogen is generally used for this purpose, resulting in a vent gas primarily composed of monomers and nitrogen. A second set of properties, known as microstructure , essentially describes the arrangement of these monomers within the polymer at the scale of a single chain. These basic structural properties play a major role in determining bulk physical properties of the polymer, which describe how the polymer behaves as a continuous macroscopic material. Chemical properties, at the nano-scale, describe how the chains interact through various physical forces. At the macro-scale, they describe how the bulk polymer interacts with other chemicals and solvents. Monomers and repeat units[ edit ] The identity of the repeat units monomer residues, also known as "mers" comprising a polymer is its first and most important attribute. Polymer nomenclature is generally based upon the type of monomer residues comprising the polymer. Polymers that contain only a single type of repeat unit are known as homopolymers, while polymers

containing two or more types of repeat units are known as copolymers. Ethylene-vinyl acetate, on the other hand, contains more than one variety of repeat unit and is thus a copolymer. Some biological polymers are composed of a variety of different but structurally related monomer residues; for example, polynucleotides such as DNA are composed of four types of nucleotide subunits. A polymer molecule containing ionizable subunits is known as a polyelectrolyte or ionomer.

**Microstructure** The microstructure of a polymer sometimes called configuration relates to the physical arrangement of monomer residues along the backbone of the chain. Structure has a strong influence on the other properties of a polymer. For example, two samples of natural rubber may exhibit different durability, even though their molecules comprise the same monomers.

**Polymer architecture** Branch point in a polymer An important microstructural feature of a polymer is its architecture and shape, which relates to the way branch points lead to a deviation from a simple linear chain. Types of branched polymers include star polymers, comb polymers, brush polymers, dendronized polymers, ladder polymers, and dendrimers. A variety of techniques may be employed for the synthesis of a polymeric material with a range of architectures, for example Living polymerization.

**Chain length**[ edit ] The physical properties [24] of a polymer are strongly dependent on the size or length of the polymer chain. Since synthetic polymerization techniques typically yield a polymer product including a range of molecular weights, the weight is often expressed statistically to describe the distribution of chain lengths present in the same. Common examples are the number average molecular weight and weight average molecular weight.

**Monomer arrangement in copolymers**[ edit ] Main article: A copolymer containing a controlled arrangement of monomers is called a sequence-controlled polymer. Alternating copolymers possess two regularly alternating monomer residues: An example is the equimolar copolymer of styrene and maleic anhydride formed by free-radical chain-growth polymerization. A statistical copolymer in which the probability of finding a particular type of monomer residue at a particular point in the chain is independent of the types of surrounding monomer residue may be referred to as a truly random copolymer [38] [39] structure 3. For example, the chain-growth copolymer of vinyl chloride and vinyl acetate is random. Polymers with two or three blocks of two distinct chemical species e. Polymers with three blocks, each of a different chemical species e. Graft or grafted copolymers contain side chains or branches whose repeat units have a different composition or configuration than the main chain.

**Tacticity** Tacticity describes the relative stereochemistry of chiral centers in neighboring structural units within a macromolecule. There are three types of tacticity:

### Chapter 6 : Polymer Chemistry: The Basic Concepts - PDF Free Download

*Mod Lec Basic Concepts on Polymers Science and Technology of Polymers by Prof. B. Adhikari, Department of Metallurgy and Material Science Mod Lec Basic definitions.*

### Chapter 7 : The Basics: Polymer Definition and Properties

*It will also be found immensely useful by advanced level students of physics, chemistry, materials science, and electronics specializing in polymers, as well as students of electronics, chemical and metallurgical engineering having courses in polymer technology/materials science and technology.*

### Chapter 8 : Fundamentals Of Polymer Science Basic Concepts | Download book

*Polymeric membranes: From basic concepts and separation mechanisms to their impact on daily life A.M. Dobos and A. Filimon\* Physical Chemistry of Polymers Department, "Petru Poni" Institute of Macromolecular Chemistry, Iasi, 41 A Grigore.*

### Chapter 9 : Basic concepts of Polymer Science | EduRev Notes

*Introduction to Polymer Chemistry Frank W. Harris Wright State University, Dayton, OH Polymers are extremely large*

*molecules that are essential to our very existence. They are a main constituent of our food.*