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Opinion Article

Regulation of Protein Polymerization by Small Molecules

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DESCRIPTION

Polymerization is the process by which a large number of monomer molecules react with each other to form a polymer. The polymer produced from the polymerization can have a linear or branched structure. They can also take the form of complex 3D networks. There are several categories of polymerization reactions, the most notable of which are step-growth polymerization, chain growth polymerization and condensation polymerization.

Polymers are substances made up of very large molecules, which are made up of many repeating units called monomers. Polymerization is the process by which these monomers come together to form the macromolecules that make up the polymer.

The complexity of the polymerization reaction mechanism can vary depending on the functional groups present in the monomer to be reacted. The simplest polymerization reaction involves the formation of a polymer from an alkene via a free radical reaction. Polyethylene, one of the most commercially important polymers, is produced by such a polymerization process (the reaction monomer used here is ethylene).

Note that polymerization containing only one type of monomer is called homopolymerization and polymerization containing multiple types of monomers is called a copolymerization process. Polymerization can be described in the simplest form of the chemical process that leads to the formation of polymers. Simply, polymerization can basically be described as the process of making a polymer. In polymerization, small molecules called monomers are bound to large molecules by a chemical reaction. A collection of these large molecules forms a polymer. The term polymer generally means a high molecular weight "polymer". They are also called macromolecules.

Polymers can be found almost anywhere in the world, from plastic shopping bags and food containers to solar cells and building and functional materials for biomedical applications. Some of these polymer materials occur naturally, but most are synthesized through a process known as polymerization.

Today, there are many different polymerization processes around the world, each capable of producing unique types of synthetic polymers and fine-tuned properties. In fact, companies produce vast amounts of polymers, over 340 million tons each year and over 60,000 different polymer materials, each with its own unique and beneficial uses.

Alkenes can be polymerized by a fairly simple radical reaction, forming useful compounds such as polyethylene and Poly Vinyl Chloride (PVC). These are mass-produced each year due to their usefulness in the manufacturing process of commercial products such as plumbing, insulation and packaging. Polymers, such as PVC, are commonly referred to as "homomopolymers" because they are composed of repeating long chains or structures of the same monomer unit, whereas polymers composed of multiple monomer units are copolymers.

Other monomeric units, such as formaldehyde hydrates and simple aldehydes, can polymerize into trimmers at very low temperatures (about 80 °C). A molecule composed of three monomer units that can be cyclized to form a cyclic ring structure or can be further reacted to form a tetramer or a compound with four monomer units. Such small polymers are called oligomers. Formaldehyde is a highly reactive electrophile and generally allows for nucleophilic addition reactions of hemiacetal intermediates. Hemiacetal intermediates are generally short-lived, relatively unstable "mid-term" compounds that react with other non-polar molecules present to form more stable macromolecular compounds.

Polymerization that is not fully relaxed and progresses rapidly can be very dangerous. This phenomenon is known as dangerous polymerization and can cause a fire or explosion.

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