

塑料加工和模具 专 业 英 语

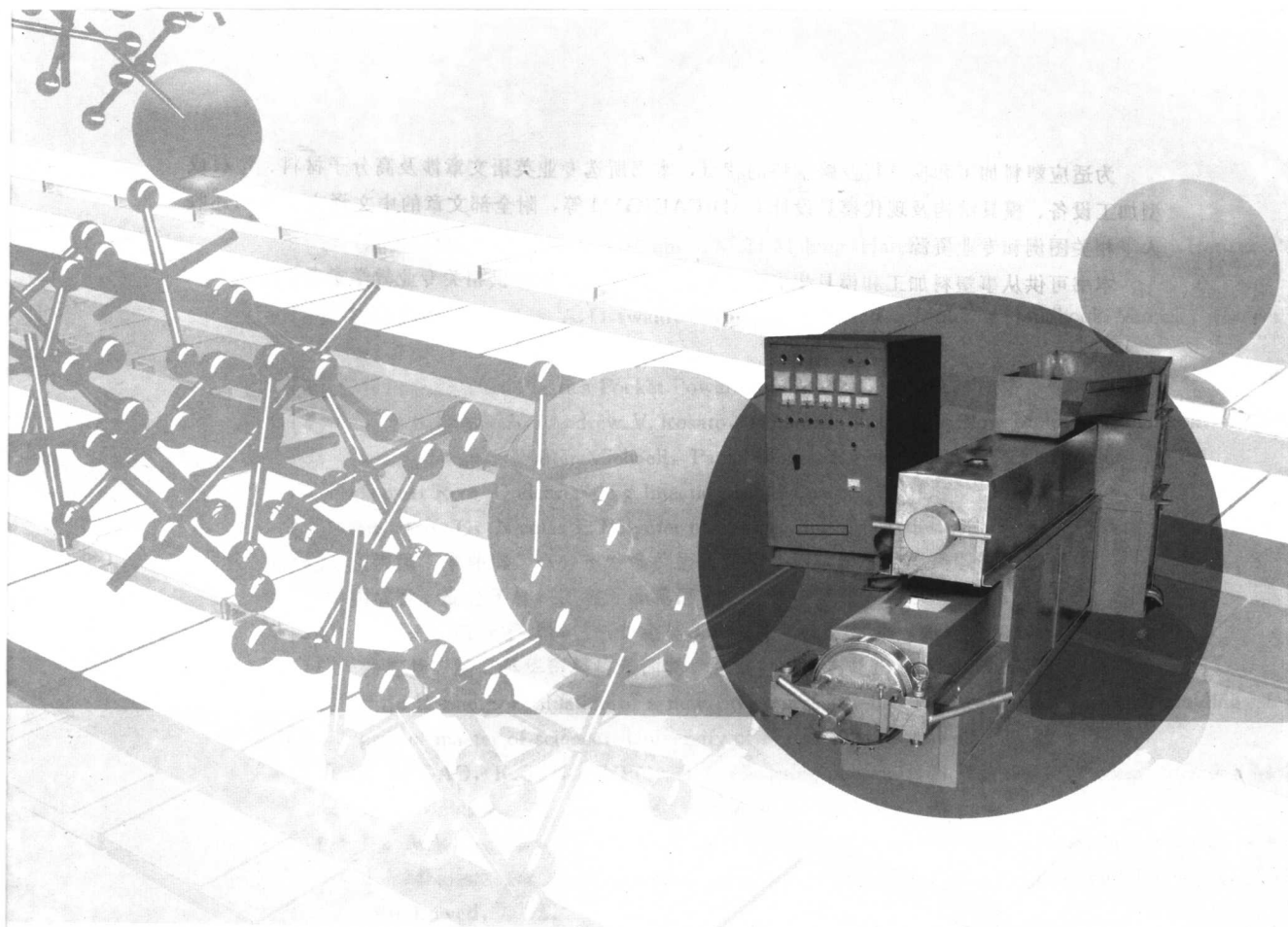
英 汉 对 照 版

张晓黎 李海梅 等编译

申长雨 主审



化学工业出版社



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· 北 京 ·

为适应塑料加工和模具行业跨学科的特点,本书所选专业英语文章涉及高分子材料、塑料成型加工设备、模具结构及现代模具设计 CAD/CAE/CAM 等,附全部文章的中文译文。本书还收入了相关图例和专业资源。

本书可供从事塑料加工和模具生产、贸易的人员使用,也可供相关专业教学参考。

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前言

中国塑料行业已在国际上产生了重要的影响,1995年到2006年连续11年以15%左右的速度增长,中国塑料制品(塑料的表观消费量)排名世界第二,仅次于美国;中国树脂产量排名世界第三;塑料机械制造业排名第一。预计到2010年我国塑料制品产量将达3750万吨,约占世界总量的50%。但塑料工业大国不等于塑料工业强国,据日本塑料工业联合会统计,中国2005年出口日本的塑料产品,数量占总量的53%,价值仅40%;而美国数量占5%,价值却高达14%。现阶段石油资源紧缺,塑料原材料价格飞涨,可持续发展以及能源、环保问题日益突出,经济大环境对塑料成型加工行业提出了开发高附加值产品,提高成型加工的技术水平和生产效率的要求。更多的人将眼界放宽,从材料、装备、技术、人才等全方位考虑产业的提升和进步。

2005年,我们根据教学和实践工作编写的《塑料加工和模具专业英语》一书在化学工业出版社的支持下出版,颇受读者欢迎。众多读者来信,希望我们能给出相关英文文字的翻译,更想知道如何进一步提高、获得专业信息知识。基于此,我们完成了本书。

本书分两部分,第一部分是基础篇,应读者要求,采用英汉对照的方式,完成专业英文文献的阅读。结构和第一部类似,老读者有熟悉亲切的感觉,新读者也使用方便,并配有部分图、词汇对应的实务图解,练习题都给出了答案。第二部分是提高篇,包括科技阅读、文献检索两方面。科技阅读部分旨在使读者掌握科技文献的特点和基本写作技巧,提高自身实力。文献检索强调的是如何通过充分发挥先进科技工具的作用,达到事半功倍的效果。

本书可供从事高分子成型加工与模具设计及加工制造的专业技术人员、大中专院校的师生参考。

参加本书编译的有张晓黎、李海梅、李永红、刘保臣、逯晓勤、何素芹、陈静波、翟震、郑国强、周子凡。

非常感谢申长雨教授百忙之中抽时间对本书稿进行审读,并提出宝贵意见。

受作者英文水平和专业知识的限制,书中若有不妥之处,恳请广大读者给予指正。

编译者

2007年5月于郑州大学

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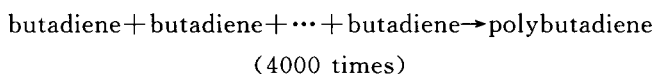
基础篇

1 Polymer chemistry & Physics

1.1 What are Polymers?

What are polymers? For one thing, they are complex and giant molecules and are different from low molecular weight compounds like, say, common salt. To contrast the difference, the molecular weight of common salt is only 58.5, while that of a polymer can be as high as several hundred thousands, even more than thousand thousands. These big molecules or 'macro-molecules' are made up of much smaller molecules. The small molecules, which combine to form a big molecule, can be of one or more chemical compounds. To illustrate, imagine that a set of rings has the same size and is made of the same material. When these rings are interlinked, the chain formed can be considered as representing a polymer from molecules of the same compound. Alternatively, individual rings could be of different sizes and materials, and interlinked to represent a polymer from molecules of different compounds.

This interlinking of many units has given the polymer its name, *poly* meaning 'many' and *mer* meaning 'part' (in Greek). As an example, a gaseous compound called butadiene, with a molecular weight of 54, combines nearly 4000 times and gives a polymer known as polybutadiene (a synthetic rubber) with about 200000 molecular weight. The low molecular weight compounds from which the polymers form are known as monomers. The picture is simply as follows:



One can thus see how a substance (monomer) with as small a molecular weight as 54 grows to become a giant molecule (polymer) of $(54 \times 4000 \approx) 200000$ molecule weight. *It is essentially the 'giantness' of the size of the polymer molecule that makes its behavior different from that of a commonly known chemical compound such as benzene.* ^① Solid benzene, for instance, melts to become liquid benzene at 5.5°C and, on further heating, boils into gaseous benzene. As against this well-defined behavior of a simple chemical compound, a polymer like polyethylene does not melt sharply at one particular temperature into clean liquid. Instead, it becomes increasingly softer and, ultimately, turns into a very viscous, tacky molten mass. Further heating of this hot, viscous, molten polymer does convert it into various gases but it is no longer polyethylene (Fig. 1.1.1).

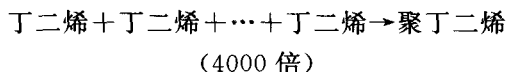
Another striking difference with respect to the behavior of a polymer and that of a low molecular weight compound concerns the dissolution process. Let us take, for example, sodium chloride and add it slowly to a fixed quantity of water. The salt, which represents a low molecular weight compound, dissolves in water up to a point (called saturation point) but, thereafter, any further quantity added does not go into solution but settles at the bottom and just remains there as solid. The viscosity of the saturated salt solution is not very much different from that of water. But if we take a polymer instead, say polyvinyl alcohol, and

1 高分子化学和物理

1.1 什么是聚合物？

什么是聚合物？首先，聚合物是比较复杂的大分子化合物，与通常所说的食盐等低分子化合物有所不同。比较一下它们的区别，食盐的分子量（相对分子质量的简称）是 58.5，而聚合物的分子量可高达几十万，甚至上百万。这些大分子物质是由比较小的分子组成的，组成大分子的小分子物质可以是一种或多种化合物。为了说明问题，试想一系列大小和组成相同的环，当它们相互连接时，就形成了可以被看作由同种化合物组成的聚合物链。另外，如果这些环的大小和组成不同，它们再相连就构成了由不同物质组成的聚合物。

许多单元相互链接即可得出聚合物的名称，在希腊语里 poly 意思是“聚”，mer 表示“单体单元”。例如，分子量为 54 的气态化合物丁二烯，以 4000 倍的聚合度聚合，可生成分子量高达二十万的聚丁二烯（一种合成橡胶）。我们称那些能生成聚合物的低分子化合物为单体，用下面的简式说明：



从中可看到分子量只有 54 的单体物质苯是如何变成分子量高达 20 万的大分子聚合物的。实际上，正是由于聚合物的巨大分子尺寸才使得其性能不同于像苯这样的一般化合物。^①例如，固态苯在 5.5℃ 时会熔化为液态，继续加热沸腾并进而变为气态苯。与一般低分子化合物受热后较分明的熔融现象不同，像聚乙烯这样的聚合物并不会在某一特定温度完全熔化为液态，而是在一温度范围内逐渐变软、熔融，最终成为高黏度的黏性熔体，继续加热，黏稠的热熔体会转变为不同的气态物质，但已经不再是聚乙烯分子了（如图 1.1.1）。

聚合物和低分子化合物的溶解过程也有明显区别。例如我们将氯化钠慢慢加入一定量的水中，低分子化合物氯化钠盐在某一极限点（饱和点）之前溶入水中，但是过了该点，加入的氯化钠不再进入溶液，而是以固态形式沉淀于容器底部，饱和盐溶液的黏度与水没有太大差别。但是如果用像聚乙烯醇这样的聚合物代替盐溶入一定量的水中，并不会立即溶解，聚

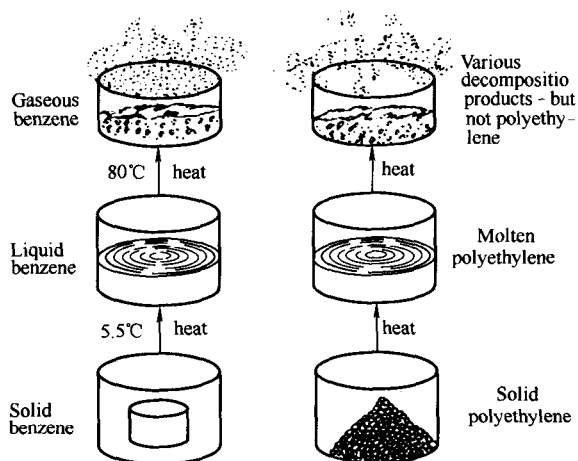


Fig. 1. 1. 1 Difference in behavior on heating of a low molecular weight compound (benzene) and a polymer (polyethylene)

add it to a fixed quantity of water, the polymer does not go into solution immediately. *The globules of polyvinyl alcohol first absorb water, swell and get distorted in shape and after a long time go into solution.* ^② Also, we can add a very large quantity of the polymer to the same quantity of water without the saturation point ever being reached. As more and more quantity of polymer is added to water, the time taken for the dissolution of the polymer obviously increases and the mix ultimately assumes a soft, dough-like consistency. *Another peculiarity is that, in water, polyvinyl alcohol never retains its original powdery nature as the excess sodium chloride does in a saturated salt solution.* ^③ In conclusion, we can say that the long time taken by polyvinyl alcohol for dissolution, the absence of a saturation point, and the increase in the viscosity are all characteristics of a typical polymer being dissolved in a solvent and these characteristics are attributed mainly to the large molecular size of the polymer. The behavior of a low molecular weight compound and that of a polymer on dissolution are illustrated in Fig. 1. 1. 2.

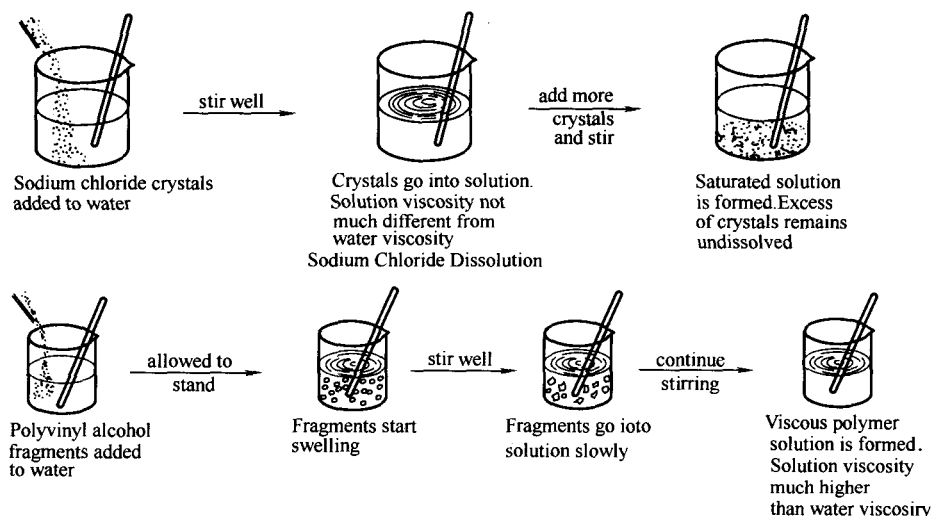


Fig. 1. 1. 2 Difference in solubility behaviour of a low molecular weight compound (sodium chloride) and a polymer (polyvinyl alcohol)

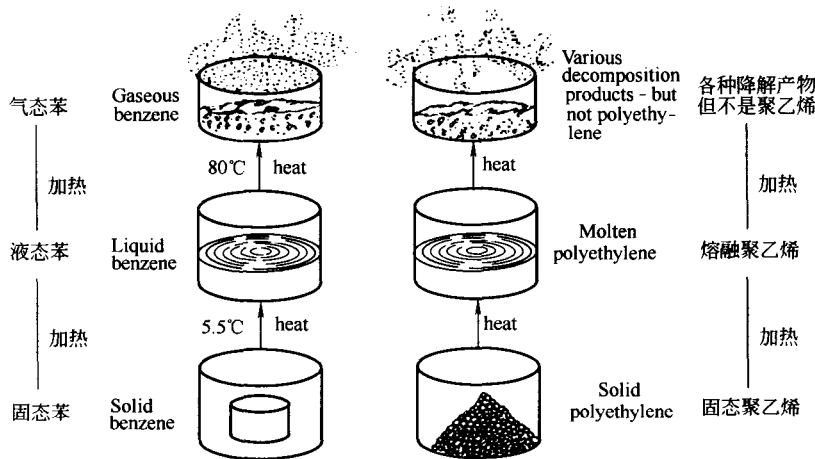


Fig. 1. 1. 1 Difference in behavior on heating of a low molecular weight compound (benzene) and a polymer (polyethylene)

图 1. 1. 1 低分子化合物（苯）和聚合物（聚乙烯）不同的受热行为

乙烯醇小颗粒首先吸水、溶胀、发生形变，经过很长时间，聚乙烯醇分子才溶解于水中。^②如果将更多的聚合物加入同量的水中，永远也不会出现饱和点。随着聚合物加入量的增多，溶解的时间明显增加，并最终形成柔软的、黏稠状物质。聚乙烯醇在水中的另一特征是：不会像过量的氯化钠在饱和盐溶液中那样保持其初始的粉末状态。^③我们可得出这样的结论：聚乙烯醇溶解所需的时间更长，没有饱和点，溶于某溶剂时黏度增加，这些都是由于聚合物庞大的分子量造成的。低分子化合物和聚合物的溶解过程详见图 1. 1. 2。

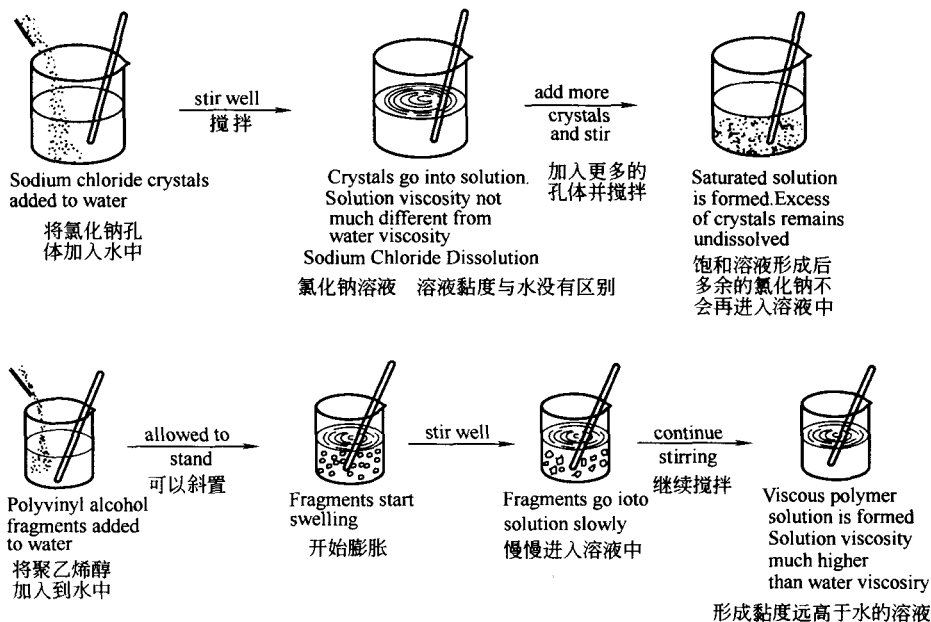


Fig. 1. 1. 2 Difference in solubility behaviour of a low molecular weight compound (sodium chloride) and a polymer (polyvinyl alcohol)

图 1. 1. 2 低分子化合物（氯化钠）和高聚物（聚乙烯醇）不同的溶解特征

New Words and Expressions

polymer *n.* 聚合物 (体), 高聚物
 common salt *n.* 食盐
 macromolecule *n.* 大分子, 高分子
 imagine *v.* 想象, 推测
 interlink *v.* 把……相互连接起来
 butadiene *n.* 丁二烯
 monomer *n.* 单体
 synthetic *a.* 合成的
 behavior *n.* 性能, 行为
 polyethylene *n.* 聚乙烯
 viscous *a.* 黏稠的
 tacky *a.* (表面) 发黏的, 粘连性
 dissolution *n.* 溶解
 dissolve *v.* 使……溶解

for one thing 首先
 with respect to 关于
 as an example 例如
 a quantity of... 大量, 一些
 as against 和……比起来

saturation *n.* 饱和
 settle *v.* 沉淀 (降) 澄清
 viscosity *n.* 黏度 (性)
 polyvinyl alcohol *n.* 聚乙烯醇
 globule *n.* 小球, 液滴, 颗粒
 swell *v. & n.* 溶胀
 dough *n.* 生面团, 揉好的面
 consistency *n.* 稠度, 黏稠性
 powdery *a.* 粉状的
 solvent *n.* 溶剂
 peculiarity *n.* 特性
 crystal *n.* 晶体, 结晶
 fragment *n.* 碎屑, 碎片

 in conclusion 总之, 最后
 convert... into... 把……转变成
 be attributed to... 归因于, 认为是……
 的结果

Exercises

1. Translate the following into Chinese.

Not all polymers are built up from bonding together a single kind of repeating unit. At the other extreme, protein molecules are polyamides in which *n* amino acid repeat units are bonded together. Although we might still call *n* the degree of polymerization in this case, it is less useful, since an amino acid unit might be any one of some 20-odd molecules that are found in proteins. In this case the molecular weight itself, rather than the degree of polymerization, is generally used to describe molecule. When the actual content of individual amino acids is known, it is their sequence that is of special interest to biochemists and molecular biologists.

2. Give a definition for each following word.

- (1) molecule
- (2) monomer
- (3) polymer

3. Put the following words into Chinese.

structure data equation pressure liquid laboratory solid
 molecule temperature measurement compound electrical

4. Put the following words into English.

科学 技术 化学 物理 气体 原子 性质 试验 增加 减少 混合物

Answers

1. 并非所有的高聚物都是由同一种重复单元结合在一起生成的，例如蛋白质分子就是由 n 个氨基酸单元组合起来形成的聚酰胺。虽然我们还可称 n 为聚合度，但意义不大，这是因为每个单元都可能是在蛋白质分子中发现的二十多种氨基酸分子中的任何一个。此时通常用分子量而非聚合度来描述分子。当单个氨基酸分子的成分已知时，令生物化学家和分子生物学家感兴趣的是其分子排序。

2. (1) Molecule is the smallest particle (usu. a group of atoms) to which a substance can be reduced by subdivision without losing its chemical identity.

(2) A simple molecule that can form polymers by combining with identical or similar molecules.

(3) A naturally occurring or synthetic substance consisting of giant molecules formed from polymerization.

3. 结构 数据 公式 压力 液体 实验室 固体 分子 温度 测试 化合物 电子的

4. science technology chemistry physics gas atom property experiment increase decrease mixture

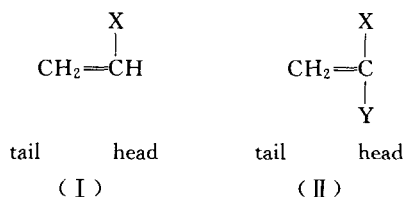
Reading Materials

Head to head polymers

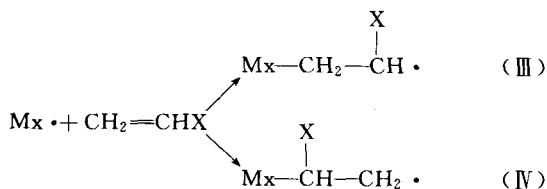
A. Definition of head to tail and head to head linkages in polymers

Substituted monomers with carbon-carbon double bonds as well as substituted cyclic monomers can be linked in principle in two ways, by the formation of head to tail (H-T) (the normal linking) or by head to head (H-H) linkages.

The definition has been established for the so-called "vinyl" monomers, substituted ethylenes, where one hydrogen atom of the ethylene groups is replaced by groups X, which might be aliphatic, aromatic or carboxylic acid groups, but might also be OR groups or halogens. The accepted nomenclature is that the "head" of the monomer is the more substituted end, while the "tail" of the monomer refers to the less substituted end. The terminology of H-H and H-T linkages in chain reaction polymers does not only apply to the monosubstituted "vinyl" monomers (I), but also to the "vinylidene" monomers which are 1,1-disubstituted (II). H-H and H-T placements can also occur on monosubstituted oxiranes (ethylene oxides), such as propylene oxide, as well as in other substituted ring compounds. While many radical polymerizations of vinyl monomers might lead to H-H linkages in the polymers, ring opening polymerization reactions can also lead to H-H linkages. Another type of polymerization that can lead to H-H linkages is the 1,4 polymers of 1-substituted butadienes, or 2-substituted butadienes; the best example is chloroprene (2-chloro-1,3-butadiene).



If the polymerization of vinyl monomers is carried out by a radical polymerization mechanism, the addition of the free radical to the vinyl monomer can occur in either of the two ways:



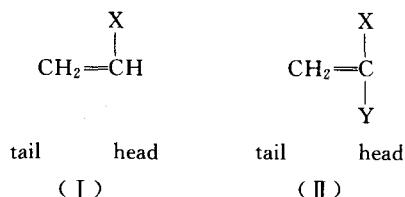
The relative rates of these alternative processes depend on the relative stability of the resulting radicals (III) and (IV). In the addition product (III), the free radical is located on the head end and the substituent is able to provide stabilization either by an inductive effect or by a resonance effect or by both to the carbon atom bearing the unpaired electron. Normally, the product radical (III) will be more stable than (IV). Secondary or tertiary radicals are known to be more stable than primary radicals due to the inductive influence of the substituent. When the substituent is providing a resonance effect (i. e. $\text{X}=\text{C}_6\text{H}_5$), the activation energy for the reaction (III) is lower than that for reaction (IV) by about 8~10kcal,

头-头相连的聚合物

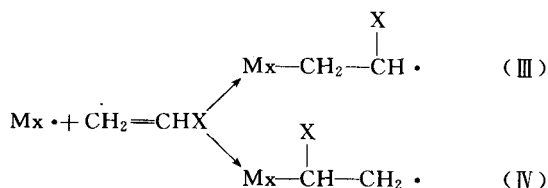
A. 头-头和头-尾聚合物的定义

带有碳碳双键的有取代基的单体和有取代基的环状单体通常有两种连接方式，即头-尾 (H-T) 和头-头 (H-H) 相连。

从所谓的“乙烯基”单体，即有取代基的乙烯可看得出来，乙烯基的一个氢原子被 X 基团取代，X 可以是脂肪族、芳香族或羰基基团，也可以是 OR 基团或卤素。将单体被取代多的一端命名为“头”，被取代少的一端称为“尾”。聚合物链反应中的头-头和头-尾的称谓既可用于单取代“乙烯”单体 (I)，也可被用于 1-1 取代的“偏乙烯” (II) 单体。头-头和头-尾取代反应还可发生在单取代环氧乙烷 (氧化乙烯) 中，如环氧丙烷和其他环状取代化合物中。一些乙烯基单体的自由基聚合反应可能会产生头-头结构，开环聚合反应也会产生头-头键接。其他类似的反应还有 1-取代丁二烯的 1,4 聚合物、2-取代丁二烯；最典型的例子是氯丁二烯 (2-氯-1,3 丁二烯)。



如果乙烯基单体的聚合反应是通过自由基聚合机理实现的，自由基在乙烯基单体上的加成有以下两种形式：



这两种反应的相对速率取决于自由基产物 (III) 和 (IV) 的相对稳定性，在加聚物 (III) 中，自由基位于头部，取代基可通过诱导效应、共振效应或同时通过这两种效应为碳原子提供稳定作用，其中碳原子带有非配对电子。通常产物 (III) 比 (IV) 更稳定，这是因为诱导作用使得二级或三级取代基比一级稳定得多。当取代基对自由基有共轭作用时 (如 X 为 C₆H₅ 时)，反应 (III) 的活化能要比 (IV) 低大约 8~10kcal，该能量足以使反应 (III)