

Polymer Science:  
A Basic Bilingual Course

# 高分子科学

## 双语基础教程

黎白钰 编



西南交通大学出版社  
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· 成 都 ·

## 内 容 简 介

本书以英文较为系统地介绍了高分子科学基础知识,内容包括高分子简史、基本概念和分类、高分子的三级结构、高分子的合成、高分子工业生产方法、高分子的热转变等。为方便学生学习,对难点内容进行了中文解释,并于书后附录中列举了化学基本词根。本书可作为化学化工类专业本、专科学生高分子双语课的教材,也可作为化学材料类本科生、研究生及相关研究人员快速掌握高分子基础知识和基本英文表达的阅读材料。

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### 图书在版编目(CIP)数据

高分子科学双语基础教程 / 黎白钰编. — 成都: 西南交通大学出版社, 2014.3  
ISBN 978-7-5643-2987-7

I. ①高… II. ①黎… III. ①高分子材料—双语教学—高等学校—教材 IV. ①TB324

中国版本图书馆CIP数据核字(2014)第052018号

---



责任编辑 牛 君

特邀编辑 杨德秀

封面设计 本格设计

西南交通大学出版社出版发行

四川省成都市金牛区交大路146号 邮政编码: 610031 发行部电话: 028-87600564

<http://press.swjtu.edu.cn>

成都勤德印务有限公司印刷

\*

成品尺寸: 185 mm × 260 mm 印张: 11.25

字数: 384千字

2014年3月第1版 2014年3月第1次印刷

ISBN 978-7-5643-2987-7

定价: 28.00元

图书如有印装质量问题 本社负责退换  
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# 前 言

自 1920 年 Staudinger 创立高分子概念，高分子科学已经历了近 100 年的发展，如今高分子已经深入科学研究、生产生活的各个方面，化学、化工、材料科学等学科与高分子的联系更是密不可分。另外，交叉学科的发展，使对高分子相关知识的需求，已经不局限于高分子专业的学生或研究人员，高分子相关课程已成为普通高等学校化学、化工、材料等专业创新型人才培养的重要内容。

编者所在学校已多年在化学、化工类专业本科教学中开设高分子科学课程。为了使学生在有限的学时内既学习高分子科学基础知识，又同时掌握基本的高分子科学英语表达，以增强学生阅读外文文献的能力，将高分子科学课程采用中英文双语教学。教学实践表明，学生在完成毕业论文、工作期间，对外文文献的阅读能力明显提高。但是，编者在教学过程中深刻体会到，在已有的图书中，很难找到一本在内容的深度和广度方面适合的教材。鉴于此，本书的编写意图就是编写一本适合于非高分子专业学生使用的高分子双语教材。

考虑到作为高分子知识的基础教程，同时也是一本高分子科学知识的快速入门读物，在本教材的编写中，注重知识的系统性，同时强调基础性，以适用于少学时教学使用。

本书主要内容包括：以英文系统介绍了高分子基本概念、高分子的结构、高分子的合成原理、工业生产方法、高分子的热转变等。

考虑到本书的使用者具有一定的英语基础，在本教材中，对涉及的高分子以及化学、化工词汇作了中文注释，同时将英文中较难的语句进行了翻译和注释，在必要的情况下，对涉及的知识点进行了较为详细的解释和补充。

为了便于读者的学习，在附录中列举了“化学专业常见字根分类简表”和“高分子国际通用缩写词”。

虽然编者已尽力认真地对待了书中每一个细节，但由于时间仓促和水平所限，错误和疏漏之处在所难免，恳请读者批评指正。

编 者

2013 年 11 月于兰州交通大学

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# CHAPTER 1

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## *Introduction*

### 1.1 Basic Concepts

A polymer is a large molecule built up from numerous smaller molecules. These large molecules may be linear, slightly branched, or highly interconnected. In the latter case the structure develops into a large three-dimensional network.

The small molecules used as the basic building blocks for these large molecules are known as monomers. For example the commercially important material poly(vinyl chloride) is made from the monomer vinyl chloride. The repeat unit in the polymer usually corresponds to the monomer from which the polymer was made. There are exceptions to this, though. Poly(vinyl alcohol) is formally considered to be made up of vinyl alcohol ( $\text{CH}_2=\text{CHOH}$ ) repeat units but there is, in fact, no such monomer as vinyl alcohol. The appropriate molecular unit exists in the alternative tautomeric form, ethanal ( $\text{CH}_3\text{CHO}$ ). To make this polymer, it is necessary first to prepare poly(vinyl ethanoate) from the monomer vinyl ethanoate, and then to hydrolyse the product to yield the polymeric alcohol<sup>[1]</sup>.

The size of a polymer molecule may be defined either by its mass or by the number of repeat units in the molecule. This latter indicator of size is called the degree of polymerisation, DP. The relative molar mass of the polymer is thus the product of the relative molar mass of the repeat unit and the DP.

There is no clear cut boundary between polymer chemistry and the rest of chemistry. As a very rough guide, molecules of relative molar mass of at least 1,000 or a DP of at least 100 are considered to fall into the domain of polymer chemistry. The vast majority of polymers in commercial use are organic in nature, that is they are based on covalent compounds of carbon. This is also true of the silicones which, though based on silicon-oxygen backbones, also generally contain significant proportions of hydrocarbon groups. The other elements involved in polymer chemistry most commonly include hydrogen, oxygen, chlorine, fluorine, phosphorus, and sulfur, i.e. those elements which are able to form covalent bonds, albeit of some polarity, with carbon.

As is characteristic of covalent compounds, in addition to primary valence forces, polymer molecules are also subject to various secondary intermolecular forces<sup>[2]</sup>. These include dipole forces between oppositely charged ends of polar bonds and dispersion forces which arise due to perturbations

of the electron clouds about individual atoms within the polymer molecule. Hydrogen bonding, which arises from the particularly intense dipoles associated with hydrogen atoms attached to electronegative elements such as oxygen or nitrogen, is important in certain polymers, notably proteins. Hydrogen bonds have the effect of fixing the molecule in a particular orientation. These fixed structures are essential for the specific functions that proteins have in the biochemical processes of life.

## Words and Phrases

polymer ['pɒlɪmə] *n.* 聚合物  
building block 基本构成部分  
monomer ['mɒnəmə] *n.* 单体  
poly(vinyl chloride) 聚氯乙烯。vinyl ['vaɪnɪl] *n.* 乙烯基; chloride ['klɔ:raɪd] *n.* 氯化物;  
vinyl chloride 氯乙烯  
poly(vinyl alcohol) 聚乙烯醇。alcohol ['ælkəhɒl] *n.* 酒精, 这里特指乙醇  
tautomeric *adj.* 互变异构的  
ethanal ['eθənæl] *n.* 乙醛, 同acetaldehyde [æsi'tældəhaɪd]  
poly(vinyl ethanoate) 聚乙酸乙烯酯, 聚醋酸乙烯酯。ethanoate [e'θeɪnəʊɪt] *n.* 醋酸酯, 醋酸盐;  
vinyl ethanoate 乙酸乙烯酯, 醋酸乙烯酯  
degree of polymerization 聚合度  
molar mass 摩尔质量  
silicone ['sɪlɪkəʊn] *n.* 聚硅氧烷  
hydrocarbon ['haɪdrəʊ'kɑ:bəʊn] *n.* 烃, 碳氢化合物  
chlorine ['klɔ:ri:n] *n.* 氯  
fluorine ['fluə:rɪn, 'flɔ:rɪn] *n.* 氟  
phosphorus ['fɒsfərəs] *n.* 磷  
sulfur ['sʌlfə] *n.* 硫, 硫黄  
albeit [ɔ:l'bi:ɪt, æl-] *conj.* 尽管, 即使  
primary valence force 主价力  
secondary intermolecular force 分子间次价力  
dipole force 偶极力。dipole ['daɪpəʊl] *n.* 偶极子  
dispersion force 色散力  
electronegative element 电负性元素  
hydrogen bond 氢键

## Notes

[1] The repeat unit in the polymer usually corresponds to the monomer from which the polymer was made. There are exceptions to this, though. Poly(vinyl alcohol) is formally considered to be made



up of vinyl alcohol ( $\text{CH}_2=\text{CHOH}$ ) repeat units but there is, in fact, no such monomer as vinyl alcohol. The appropriate molecular unit exists in the alternative tautomeric form, ethanal ( $\text{CH}_3\text{CHO}$ ). To make this polymer, it is necessary first to prepare poly(vinyl ethanoate) from the monomer vinyl ethanoate, and then to hydrolyse the product to yield the polymeric alcohol.

聚合物的重复单元通常对应着构成它的单体，但也有例外。聚乙烯醇从形式上可以认为是由乙烯醇( $\text{CH}_2=\text{CHOH}$ )重复单元构成的，但是，事实上没有乙烯醇这种单体。其合理的分子单元以另一种异构体乙醛的形式存在。要合成这种聚合物，需要先从乙酸乙烯酯单体制成聚乙酸乙烯酯，然后将产物水解得到聚合态的醇。

[2] As is characteristic of covalent compounds, in addition to primary valence forces, polymer molecules are also subject to various secondary intermolecular forces.

因为具有共价键化合物的特征，所以除了主价力外，聚合物分子也受到各种分子间次价力的作用。

be characteristic of ... “具有……的特征”。

## 1.2 The History of the Concept of the Macromolecule

Modern books about polymer chemistry explain that the word polymer is derived from the Greek words ‘poly’ meaning many and ‘meros’ meaning part. They often then infer that it follows that this term applies to giant molecules built up of large numbers of interconnected monomer units<sup>[1]</sup>. In fact this is misleading since historically the word polymer was coined for other reasons. The concept of polymerism was originally applied to the situation in which molecules had identical empirical formulae but very different chemical and physical properties. For example, benzene ( $\text{C}_6\text{H}_6$ ; empirical formula  $\text{CH}$ ) was considered to be a polymer of acetylene ( $\text{C}_2\text{H}_2$ ; empirical formula also  $\text{CH}$ ). Thus the word ‘polymer’ is to be found in textbooks of organic chemistry published up to about 1920 but not with its modern meaning.

The situation is confused, however, by the case of certain chemicals. Styrene, for example, was known from the mid-nineteenth century as a clear organic liquid of characteristic pungent odour. It was also known to convert itself under certain circumstances into a clear resinous solid that was almost odour-free, this resin then being called metastyrene. The formation of metastyrene from styrene was described as a polymerisation and metastyrene was held to be a polymer of styrene. However, these terms applied only in the sense that there was no change in empirical formula despite the very profound alteration in chemical and physical properties. There was no understanding of the cause of this change and certainly the chemists of the time had no idea of what had happened to the styrene that was remotely akin to the modern view of polymerisation<sup>[2]</sup>.

Understanding of the fundamental nature of those materials now called polymers had to wait until the 1920s, when Herman Staudinger coined the word ‘macromolecule’ and thus clarified thinking.

There was no ambiguity about this new term — it meant ‘large molecule’, again from the Greek, and these days is used almost interchangeably with the word polymer. Strictly speaking, though, the words are not synonymous. There is no reason in principle for a macromolecule to be composed of *repeating* structural units; in practice, however, they usually are. Staudinger’s concept of macromolecules was not at all well received at first. His wife once recalled that he had ‘encountered opposition in all his lectures’. Typical of this opposition was that of one distinguished organic chemist who declared that it was as if zoologists ‘were told that somewhere in Africa an elephant was found who was 1,500 feet long and 300 feet high’<sup>[3]</sup>.

There were essentially three reasons for this opposition. Firstly, many macromolecular compounds in solution behave as colloids. Hence they were assumed to be identical with the then known inorganic colloids. This in turn implied that they were not macromolecular at all, but were actually composed of small molecules bound together by ill-defined secondary forces. Such thinking led the German chemist C. D. Harries to pursue the search for the ‘rubber molecule’ in the early years of the twentieth century. He used various mild degradations of natural rubber, which he believed would destroy the colloidal character of the material and yield its constituent molecules, which were assumed to be fairly small. He was, of course, unsuccessful.

The second reason for opposition to Staudinger’s hypothesis was that it meant the loss of the concept of a single formula for a single compound. Macromolecules had to be written in the form  $(\text{CH}_2=\text{CHX})_n$ , where  $n$  was a large number. Moreover, no means were available, or indeed are available, for discretely separating molecules where  $n=100$  from those where  $n=101$ . Any such attempted fractionation always gives a distribution of values of  $n$  and, even if the mean value of a fraction is actually  $n=100$ , there are significant numbers of molecules of  $n=99$ ,  $n=101$ , and so on<sup>[4]</sup>. Now the concept of one compound, one formula, with one formula being capable of both physical (i.e. spatial) and chemical interpretation, had been developed slowly and at some cost, with many long, hard-fought battles. Organic chemists could not easily throw it out, particularly in view of the fact that it had been so conspicuously successful with much of the rest of organic chemistry.

The third reason for opposition lay in the nature of many of the polymeric materials then known. Not only were they apparently ill-characterised, but they were also frequently non-crystalline, existing as gums and resins. Just the sort of unpromising media, in fact, from which dextrous organic chemists had become used to extracting crystalline substances of well characterised physical and chemical properties. To accept such resins as inherently non-crystallizable and not capable of purification in the traditional sense of the word was too much for the self-esteem of many professional organic chemists<sup>[5]</sup>.

Staudinger’s original paper opposing the prevalent colloidal view of certain organic materials was published in 1920 and contained mainly negative evidence. Firstly, he showed that the organic substances retained their colloidal nature in all solvents in which they dissolve; by contrast, inorganic colloids lose their colloidal character when the solvent is changed. Secondly, contrary to what would have been expected, colloidal character was able to survive chemical modification of the original substance.

By about 1930 Staudinger and others had accumulated much evidence in favour of the

macromolecular hypothesis. The final part in establishing the concept was carried out by Wallace Carothers of the Du Pont company in the USA. He began his work in 1929 and stated at the outset that the aim was to prepare polymers of definite structure through the use of established organic reactions. Though his personal life was tragic, Carothers was an excellent chemist who succeeded brilliantly in his aim. By the end of his work he had not only demonstrated the relationship between structure and properties for a number of polymers, but he had invented materials of tremendous commercial importance, including neoprene rubber and the nylons.

## Words and Phrases

coin [kɔɪn] *n.* 硬币; *vt.* 铸造, 创造 (新词), 这里是创造新词的意思  
 polymerism [pɔ'limərizm] *n.* 聚合 (性), 聚合 (现象)  
 benzene ['benzi:n] *n.* 苯  
 acetylene [ə'setili:n] *n.* 乙炔  
 empirical formula 经验式  
 pungent ['pʌndʒənt] *n.* 刺鼻的; 尖锐的  
 resinous ['rezinəs] *adj.* 树脂的, 树脂质的, 树脂制的。resin ['rezin] *n.* 树脂  
 metastyrene [metə'staɪri:n] *n.* 介苯乙烯  
 ambiguity [ˌæmbɪ'ɡju:ɪti] *n.* 模棱两可  
 ill-defined 不清楚的  
 discretely 不连续的, 离散的  
 fractionation (聚合物) 分级  
 non-crystalline 非结晶的。crystalline ['krɪstəlɪn] *adj.* 结晶的  
 ill-characterised 表征不清楚的。characterise ['kærɪktəraɪz] *vt.* 表征  
 dextrous ['dekstrəs] *adj.* 机巧的, 聪明的  
 macromolecular [ˌma:krəʊ'mɒli,kju:lə] *adj.* 大分子的  
 hypothesis [haɪ'pɒθɪsɪs] *n.* 假说, 假设, 前提

## Notes

[1] Modern books about polymer chemistry explain that the word polymer is derived from the Greek words 'poly' meaning many and 'meros' meaning part. They often then infer that it follows that this term applies to giant molecules built up of large numbers of interconnected monomer units.

现代关于聚合物化学的书籍将 polymer 一词解释为源自意思为许多的希腊词 "poly" 和意思为部分的希腊词 "meros"。也因此推断, 这一词 (polymer) 适用于由大量相互连接的单体单元构成的巨大分子。

infer *vt.* 推断, 推论

infer that it follows that... 后一个 that 之后是 it 所指代的部分。

这句话如果直译就是：他们因此推断，随之而来的是这一术语（term）适用于由大量相互连接的单体单元构成的巨大分子。

[2] The formation of metastyrene from styrene was described as a polymerisation and metastyrene was held to be a polymer of styrene. However, these terms applied only in the sense that there was no change in empirical formula despite the very profound alteration in chemical and physical properties. There was no understanding of the cause of this change and certainly the chemists of the time had no idea of what had happened to the styrene that was remotely akin to the modern view of polymerisation.

介苯乙烯的形成被描述为聚合现象，且认为介苯乙烯是苯乙烯的聚合物。然而，这些术语仅在化学经验式不发生变化的意义下适用，不管化学和物理性质发生了多么深刻的变化。当时条件下，对发生这些变化的原因不能理解，所以当时的化学家当然根本不知道苯乙烯发生的变化，也没有与现代聚合观点相似的观念。

that was remotely akin to... 是 idea 的定语。

[3] Staudinger's concept of macromolecules was not at all well received at first. His wife once recalled that he had 'encountered opposition in all his lectures'. Typical of this opposition was that of one distinguished organic chemist who declared that it was as if zoologists 'were told that somewhere in Africa an elephant was found who was 1,500 feet long and 300 feet high'.

Staudinger 的大分子概念起初根本不能被普遍接受。他的妻子曾回忆到，他几乎“在所有的演讲中都遭到反对”。其中，一位有机化学家比较典型，他宣称（Staudinger 的理论）就如告诉一位动物学家“有人在非洲发现了一头 1,500 英尺长 300 英尺高的大象”。

“Typical of this opposition was ...” 是倒装句，that of one distinguished organic chemist，其中 that 指 opposition。

[4] Moreover, no means were available, or indeed are available, for discretely separating molecules where  $n=100$  from those where  $n=101$ . Any such attempted fractionation always gives a distribution of values of  $n$  and, even if the mean value of a fraction is actually  $n=100$ , there are significant numbers of molecules of  $n=99$ ,  $n=101$ , and so on.

另外，没有方法，事实上也没方法用来将  $n=100$  的分子从  $n=101$  的分子中分离出来。任何分离尝试总是得到  $n$  值的一个分布，即使分离出的一个级分的平均  $n=100$ ，也会存在大量的  $n=99$ ， $n=101$  等的分子。

[5] To accept such resins as inherently non-crystallizable and not capable of purification in the traditional sense of the word was too much for the self-esteem of many professional organic chemists.

从传统意义上，要接受这些树脂本质上是非结晶的而且不可能纯化这样的观点，对很多职业有机化学家的自尊来讲有些过分。

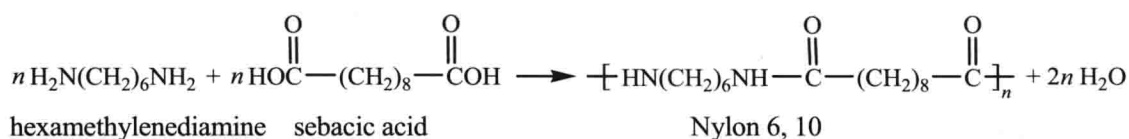
## 1.3 Polymer Nomenclature

There is wide diversity in the practice of naming polymers, we will concentrate on the most utilized systems.

### 1.3.1 Common Names

Little rhyme or reason is associated with the common names of polymers. Some names are derived from the place of origin of the material, such as *Hevea brasiliensis* — literally “rubber from Brazil” — for natural rubber. Other polymers are named after their discoverer, as is Bakelite, the three-dimensional polymer produced by condensation of phenol and formaldehyde, which was commercialized by Leo Baekeland in 1905<sup>[1]</sup>.

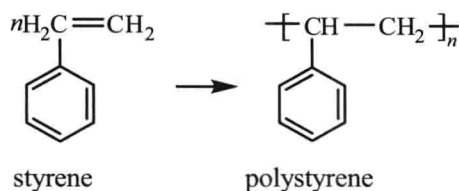
For some important groups of polymers, special names and systems of nomenclature were invented. For example, the nylons were named according to the number of carbons in the diamine and carboxylic acid reactants (monomers) used in their syntheses. The nylon produced by the condensation of hexamethylenediamine (6 carbons) and sebacic acid (10 carbons) is called nylon 6,10<sup>[2]</sup>.



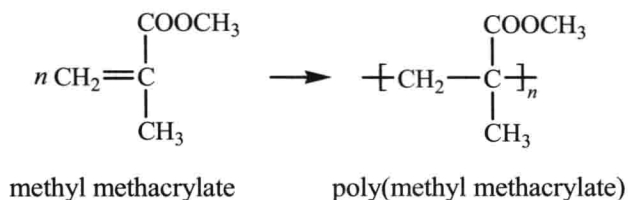
Similarly, the polymer from hexamethylenediamine and adipic acid (each with 6 carbons) is called nylon 6, 6 or nylon 66, and the nylon from the single reactant caprolactam (6 carbons) is called nylon 6.

### 1.3.2 Source-based Names

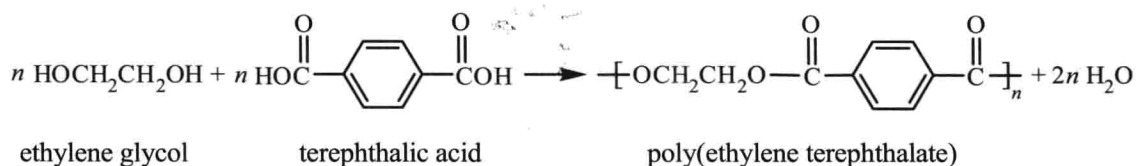
Most polymer names used by polymer scientists are source-based; i.e., they are based on the common name of the reactant monomer, preceded by the prefix “poly”. For example, polystyrene is the most frequently used name for the polymer derived from the monomer 1-phenylethene, which has the common name styrene.



The vast majority of polymers based on the vinyl group ( $\text{CH}_2=\text{CHX}$ ) or the vinylidene group ( $\text{CH}_2=\text{CX}_2$ ) as the repeat unit are known by their source-based names. For example, polyethylene is derived from the monomer ethylene, poly(vinyl chloride) from the monomer vinyl chloride, and poly(methyl methacrylate) from methyl methacrylate<sup>[3]</sup>.



Many condensation polymers are also named in this manner. In the case of poly(ethyleneterephthalate), the glycol portion of the name of the monomer, ethylene glycol, is used in constructing the polymer name, so that the name is actually a hybrid of a source-based and a structure-based name<sup>[4]</sup>.



This polymer is well known by trade names, such as Dacron, or its common grouping, polyester. Although it is often suggested that parentheses be used in naming polymers of more than one word [like poly(vinylidene chloride)] but not for single-word polymers (like polyethylene), many authors omit entirely the use of parentheses for either case (like polyvinylidene chloride). Thus there exists a variety of practices with respect to even source-based names<sup>[5]</sup>.

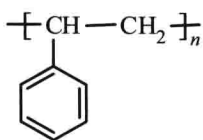
Copolymers are composed of two or more monomer units. Source-based names are conveniently used to describe copolymers by using an appropriate term between the names of the monomers. Any of a half dozen or so connecting terms may be used, depending on what is known about the structure of the copolymer. When no information is specified about the sequence of monomer units in the copolymer, the connective term *co* is used in the general format poly(A-*co*-B), where A and B are the names of the two monomers. An unspecified copolymer of styrene and methyl methacrylate would be called poly[styrene-*co*-(methyl methacrylate)]<sup>[6]</sup>.

Kraton, the yellow rubber-like material on the bottom of many running shoes, is an example of a copolymer about which structural information is available. It is formed from a group of styrene units, i.e., a “block” of polystyrene, attached to a group of butadiene units, or a block of polybutadiene, which is attached to another block of polystyrene forming a triblock copolymer. The general representation of such a block copolymer is—AAAABBBBBAAAAA—, where each A or B represents an individual monomer unit. The proper source-based name for Kraton is polystyrene-*block*-polybutadiene-*block*-polystyrene, with the prefix “poly” being retained for each block<sup>[7]</sup>.

### 1.3.3 Structure-based Names

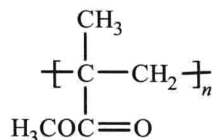
Although source-based names are generally employed for simple polymers, the international body responsible for systematic nomenclature of chemicals, IUPAC, has published a number of reports for the naming of polymers, now being accepted for more complex polymers. The IUPAC system names the components of the repeat unit, arranged in a prescribed order. The rules for selecting the order of the components to be used as the repeat unit are found elsewhere. However, once the order is selected, the naming is straightforward for simple linear molecules, as indicated in the following examples<sup>[8]</sup>:

polystyrene



poly(1-phenylethylene)

poly(methyl methacrylate)



poly[1-(methoxycarbonyl)-1-methylethylene]

A listing of source- and structure-based names for some common polymers is given in Table 1.1<sup>[9]</sup>.

Table 1.1 Source- and Structure-based Names

Source-based Names	Structure-based Names
Polyacrylonitrile	Poly(1-cyanoethylene)
Poly(ethylene oxide)	Poly(oxyethylene)
Poly(ethylene terephthalate)	Poly(oxyethyleneoxyterephthaloxyl)
Polyisobutylene	Poly(1, 1-dimethylethylene)
Poly(methyl methacrylate)	Poly[(1-methoxycarbonyl)-1-methylethylene]
Polypropylene	Poly(1-methylethylene)
Polystyrene	Poly(1-phenylethylene)
Polytetrafluoroethylene	Poly(difluoromethylene)
Poly(vinyl acetate)	Poly(1-acetoxyethylene)
Poly(vinyl alcohol)	Poly(1-hydroxyethylene)
Poly(vinyl chloride)	Poly(1-chloroethylene)
Poly(vinyl butyral)	Poly[(2-propyl-1, 3-dioxane-4, 6-diyl)methylene]

### 1.3.4 Linkage-based Names

Many polymer “families” are referred to by the name of the particular linkage that connects the polymers (Table 1.2). The family name is “poly” followed by the linkage name. Thus, those polymers that contain the carbonate linkage are known as polycarbonates; those containing the ether linkage are called polyethers, etc.

Table 1.2 Linkage-based Names

Family Name	Linkage	Family Name	Linkage
Polyamide	$\text{—N—}\overset{\text{O}}{\parallel}\text{C—}$	Polyvinyl	$\text{—C—C—}$
Polyester	$\text{—O—}\overset{\text{O}}{\parallel}\text{C—}$	Polyanhydride	$\overset{\text{O}}{\parallel}\text{C—O—}\overset{\text{O}}{\parallel}\text{C—}$
Polyurethane	$\text{—O—}\overset{\text{O}}{\parallel}\text{C—N—}$	Polyurea	$\text{—N—}\overset{\text{O}}{\parallel}\text{C—N—}$
Polyether	$\text{—O—}$	Polycarbonate	$\text{—O—}\overset{\text{O}}{\parallel}\text{C—O—}$
Polysiloxane	$\text{—O—Si—}$	Polyphosphate ester	$\text{—O—}\overset{\text{O}}{\parallel}\text{P—O—R—}$   OR
Polysulfide	$\text{—S—R—}$	Polysulfones	$\overset{\text{O}}{\parallel}\text{—S—}$    O

## Words and Phrases

nomenclature [nəu'menklətʃə] *n.* 名称, 命名法, 术语  
formaldehyde [fɔ:'mældihaid] *n.* 甲醛  
hexamethylenediamine 己二胺  
sebacic acid [si'bæsik 'æsid] *n.* 癸二酸  
adipic acid [ə'dipik 'æsid] *n.* 己二酸  
caprolactam [kæprəu'læktəm] *n.* 己内酰胺  
vinyl ['vainl] *n.* 乙烯基  
vinyl chloride 氯乙烯  
methyl methacrylate 甲基丙烯酸甲酯。methacrylate [me'θækrəleit] 甲基丙烯酸酯  
poly(ethyleneterephthalate) 聚对苯二甲酸乙二酯。terephthalate ['te,rɛf'θæleit] 对苯二甲酸酯(盐)  
glycol [glaikɔl] *n.* 乙二醇, 二羟基醇  
dacron ['dækrɒn] *n.* 涤纶, 聚酯纤维

## Notes

[1] Little rhyme or reason is associated with the common names of polymers. Some names are derived from the place of origin of the material, such as *Hevea brasiliensis* — literally “rubber from Brazil” — for natural rubber. Other polymers are named after their discoverer, as is Bakelite, the three-dimensional polymer produced by condensation of phenol and formaldehyde, which was commercialized by Leo Baekeland in 1905.

聚合物的常用名几乎没有规律可循。有些名称源自其产地, 比如将 *Hevea brasiliensis*——字面意思是“来自巴西的橡胶”——作为天然橡胶的名称。其他聚合物是以其发现者来命名的, 如 Bakelite 是由苯酚和甲醛缩合而生成的三维聚合物, 由 Leo Baekeland 于 1905 年实现工业化的。

rhyme or reason 逻辑, 情理。rhyme[raim] 本身的含义是指诗文的押韵。

[2] For some important groups of polymers, special names and systems of nomenclature were invented. For example, the nylons were named according to the number of carbons in the diamine and carboxylic acid reactants (monomers) used in their syntheses. The nylon produced by the condensation of hexamethylenediamine (6 carbons) and sebacic acid (10 carbons) is called nylon 6, 10.

对于一些重要的聚合物类型, 创造了特殊的名称和系统的命名法。例如, 根据合成时所用反应物二胺和羧酸(单体)的碳原子数来命名尼龙, 由己二胺(6 碳原子)和癸二酸合成的尼龙称为尼龙 6, 10。

[3] The vast majority of polymers based on the vinyl group ( $\text{CH}_2=\text{CHX}$ ) or the vinylidene group ( $\text{CH}_2=\text{CX}_2$ ) as the repeat unit are known by their source-based names. For example, polyethylene is derived from the monomer ethylene, poly(vinyl chloride) from the monomer vinyl chloride, and poly(methyl methacrylate) from methyl methacrylate:

绝大多数以乙烯基或亚乙烯基(单体)作为重复单元的聚合物采用了基于来源的名称。如



聚乙烯得自单体乙烯, 聚氯乙烯得自单体氯乙烯, 聚甲基丙烯酸甲酯得自单体甲基丙烯酸甲酯。

vast majority 绝大多数

以来源命名时, 英文中一般将单体括起来, 而在中文中, 直接在单体前加“聚”字。如本文中“poly(vinyl chloride)”可用中文表示为“聚氯乙烯”。

[4] Many condensation polymers are also named in this manner. In the case of poly(ethyleneterephthalate), the glycol portion of the name of the monomer, ethylene glycol, is used in constructing the polymer name, so that the name is actually a hybrid of a source-based and a structure-based name.

很多缩合聚合物也以这种方式命名。对于聚对苯二甲酸乙二酯, 单体名称的二醇部分——乙二醇——也用于构成聚合物的名称, 因此, 该聚合物的名称实际上是基于来源和基于结构的名称的混合体。

[5] This polymer is well known by trade names, such as Dacron, or its common grouping, polyester. Although it is often suggested that parentheses be used in naming polymers of more than one word [like poly(vinylidene chloride)] but not for single-word polymers (like polyethylene), many authors omit entirely the use of parentheses for either case (like polyvinylidene chloride). Thus there exists a variety of practices with respect to even source-based names.

这种聚合物的商品名(如涤纶)或通用分类名称(聚酯)为人们所熟悉。尽管有提议在由多于一个的词构成的聚合物名称前加括号[如 poly(vinylidene chloride)], 而在由一个词构成的聚合物名称中不用括号(如 polyethylene), 很多作者在两种情形下都完全省略了括号(如 polyvinylidene chloride)。因此, 甚至对基于来源的名称也存在多种命名方式。

[6] Copolymers are composed of two or more monomer units. Source-based names are conveniently used to describe copolymers by using an appropriate term between the names of the monomers. Any of a half dozen or so connecting terms may be used, depending on what is known about the structure of the copolymer. When no information is specified about the sequence of monomer units in the copolymer, the connective term *co* is used in the general format poly(A-*co*-B), where A and B are the names of the two monomers. An unspecified copolymer of styrene and methyl methacrylate would be called poly[styrene-*co*-(methyl methacrylate)].

共聚物由两种或两种以上的单体单元构成。通过在单体名称间使用适当的连接词, 基于来源的名称可方便地用于描述共聚物。可用的连接词有约半打, 用哪种连接词取决于对共聚物结构的认识。如果没有单体单元在共聚物中的任何信息, 这时采用连接词 *co*, 其通用的格式是 poly(A-*co*-B), 其中 A 和 B 是两种单体的名称。未定义的苯乙烯和甲基丙烯酸甲酯的共聚物可以称为聚(苯乙烯-*co*-甲基丙烯酸甲酯)。

根据《高分子化学命名原则》(全国科学技术名词审定委员会公布, 2005), 中文共聚物的命名方法如下:

(1) 以“聚”字开始, 然后在括号中共聚合的单体之间插入表示共聚合方式的中介连接字符, 如聚(苯乙烯-*co*-丙烯腈), 表示未定义的 (unspecified) 共聚物。其读法是以“共聚物”为后缀词, 读作“苯乙烯-丙烯腈共聚物”。

(2) 将共聚合的单体先用中介符号“-”(有时也用“/”)分开, 最后加入与共聚合方式相应的共聚物后缀词, 未定义的共聚物写作“苯乙烯-丙烯腈共聚物”。具体用法如表 1.3。