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COMMISSION ON MACROMOLECULAR NOMENCLATURE\*  
SUBCOMMITTEE ON MACROMOLECULAR TERMINOLOGY and  
SUBCOMMITTEE ON POLYMER TERMINOLOGY

# GLOSSARY OF CLASS NAMES OF POLYMERS BASED ON CHEMICAL STRUCTURE AND MOLECULAR ARCHITECTURE

(IUPAC Provisional Recommendations)

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# Glossary of class names of polymers based on chemical structure and molecular architecture

## (IUPAC Provisional Recommendations)

*Abstract:* This document defines class names of polymers based on the class names of starting monomers and characteristic features of the chemical constitution of polymer molecules (macromolecules), i.e., class names that have gained general acceptance in the polymer and material literature, science and technology as well as in public. The glossary is divided into three parts:

- Source-based class names, which identify common classes of starting monomers such as “acrylic”, “diene”, “phenolic”, “vinyllic”.
- Class names based on chemical structure, which identify characteristic groups in the main chains (backbones) of the polymer molecules such as (i) inter-unit groups derived from functional groups, e.g., “amide”, “ester”, “ether”; (ii) a specific group of atoms, e.g., “alkenylene”, “siloxane”, “sulfone”; (iii) ring structures, e.g., “benzimidazole”, “benzoxazole”, “quinoxaline”.
- Class names based on molecular architecture, which identify mainly the overall shapes of polymer molecules through the type of their graphical representation such as “linear”, “branched”, “dendritic”, “comb”.

Each part of the glossary is arranged in a non-hierarchical alphabetical order. Each entry provides: a) the polymer class name; b) its definition; c) specific or generic examples including IUPAC names and a structure or graphical representation; d) relations to other polymer classes and subclasses; e) notes on the inclusion or exclusion of borderline cases. Alphabetical index of all class names is included.

*Keywords:* IUPAC Polymer Division; macromolecule architecture, polymer class names; source-based polymer names; structure-based polymer names;

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## 1. INTRODUCTION

In chemistry, a class is a set of compounds sharing a common structural feature to which is attached a variable part (or parts) defining a specific compound of the class. The common feature is often a functional group to which one or a small number of variable parts are attached. This is the principle applied to the published “Glossary of Class Names of Organic Compounds” by the former IUPAC Commission on Nomenclature of Organic Chemistry [1].

The former Commission on Macromolecular Nomenclature provided earlier a somewhat different type classification of linear single-strand polymers [2], based on the elemental composition of the repeating units in the main chain (backbone):

*homochain polymers* in which the main chains are constructed from atoms of a single element, and

*heterochain polymers* in which the main chains are constructed from atoms of two or more elements.

Within each class, subclasses such as “carbon-chain polymers”, “sulfur-chain polymers”, “(oxygen, carbon)-chain polymers”, and “(oxygen, nitrogen, carbon)-chain polymers” are further defined, and within each subclass such

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2  
3 structures as “polyalkylene”, “polyether”, “polyester”, “polycarbonate”, “polysulfone”, and “polyurea” are further  
4 identified.

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6 It is this last type of class, based largely on the inter-unit groups in a polymer backbone that has gained general  
7 acceptance in the polymer literature. It has been used in polymer textbooks, handbooks [3,4], encyclopedias [5-7],  
8 and indexes [8]. Such names are useful, not only for classifying chemical structure but also for describing related  
9 materials processing and properties. The present recommendations are an extension of the classification of linear  
10 single-strand polymers [2], the glossary of basic terms in polymer science [9] and the glossary of class names of  
11 organic compounds [1], in order to name polymers in a general structural sense. They may also be viewed as an  
12 extension of the generic source-based nomenclature for polymers [10-12].

13  
14 The former Commission on Macromolecular Nomenclature has recognized in its earlier recommendations [11,  
15 12] that not all polymers can be identified and named on the basis of their structural features [13, 14]. That situation  
16 has led to two systems of macromolecular nomenclature, source-based and structure-based. Source-based polymer  
17 names identify the monomers used whereas structure-based polymer names identify constitutional repeating units  
18 present in macromolecules. This approach is also reflected in the present document on polymer class names.

19  
20 As in all classifications of chemical compounds, the classes are not mutually exclusive. On the contrary, because  
21 of the presence of more than one type of inter-unit groups, or more than one characteristic group in the backbone, a  
22 polymer may belong to two or more different classes, e.g., “polyamide” and “polyester”, or to a combined class such  
23 as “polyetherketone”. Some “polysilsesquioxanes” may also be classified on the basis of their molecular  
24 architectures as “ladder polymers” and “hyperbranched polymers”.

25 Each part of the glossary is arranged in a non-hierarchical alphabetical order. Each entry provides:

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- a) the polymer class name;
  - b) its definition based on the source (Chapter 2) or main structural feature (Chapter 2) or molecular architecture (Chapter 3);
  - c) specific or generic examples;
  - d) relations to other polymer classes and subclasses;
  - e) notes on the inclusion or exclusion of borderline cases.

For monomers, recommended systematic IUPAC names [15] are used as well as semisystematic or trivial names well established by usage [16].

The polymer class names are defined in the singular to enable an individual polymer within a class to be referred to by using the indefinite article, “a”. For example, poly(3-octylthiophene) is a polythiophene and polythiophene itself is also a polythiophene.

## 2. SOURCE-BASED CLASS NAMES

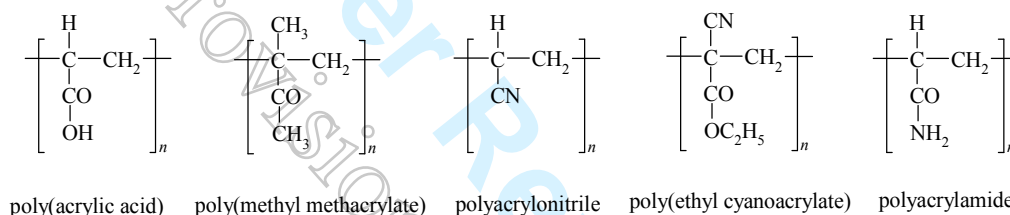
### 2.1 acrylic polymer acrylic polyacrylic acrylate polymer

Polymer prepared from acrylic acid or a derivative of acrylic acid.

*Note 1:* Examples of derivatives of acrylic acid are esters, amides, nitriles, chlorides and aldehydes.

*Note 2:* An acrylic polymer formed from methacrylic acid and related monomers is often referred to as a *methacrylic polymer* or a *polymethacrylic* or a *methacrylate polymer*. *Methacrylic polymers* are a subclass of acrylic polymers.

*Note 3:* The macromolecule of a regular acrylic homopolymer can be described by a repeating constitutional unit of general formula:  $-\text{CR}(\text{X})-\text{CH}_2-$ , where R is  $\text{COOH}$ ,  $\text{COOR}^1$ ,  $\text{CN}$ , or  $\text{CONR}^1\text{R}^2$  and X is H, alkyl, aryl, heteroaryl, or CN.



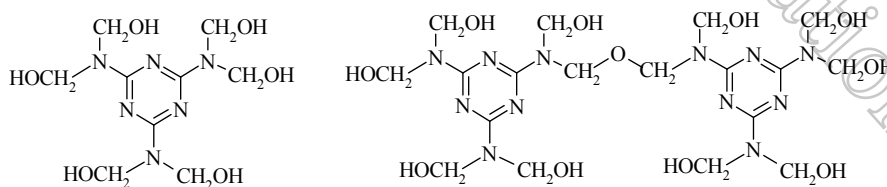
poly(acrylic acid) poly(methyl methacrylate) polyacrylonitrile poly(ethyl cyanoacrylate) polyacrylamide

### 2.2 amino polymer

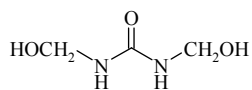
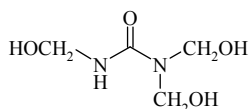
Polymer prepared by polycondensation of an amine or amide with an aldehyde, or by curing reactive oligomers prepared from an amine or amide and an aldehyde.

*Note 1:* Formaldehyde is commonly used as the aldehyde and (a) melamine or (b) urea as the amine. The resulting polymer is named (a) *melamine polymer* or *melamine-formaldehyde polymer*, *urea polymer* or *urea-formaldehyde polymer*.

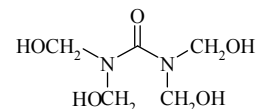
*Note 2:* A mixture of the reactive oligomers prepared by the condensation of an amine or amide with an aldehyde is usually referred to as an *amino resin*, e.g., *melamine-formaldehyde resin* or *urea-formaldehyde resin*. Examples of the oligomers present in melamine-formaldehyde and urea-formaldehyde resins are:



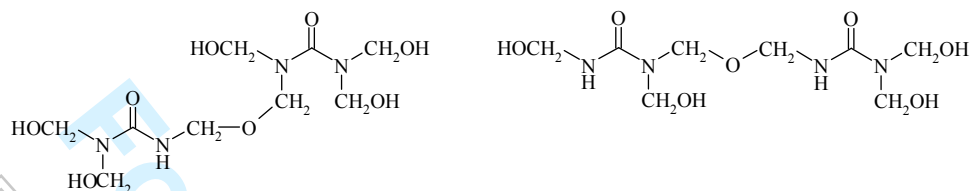
Examples of oligomeric species present in a melamine-formaldehyde resin

*N,N'*-bis(hydroxymethyl)urea

tris(hydroxymethyl)urea



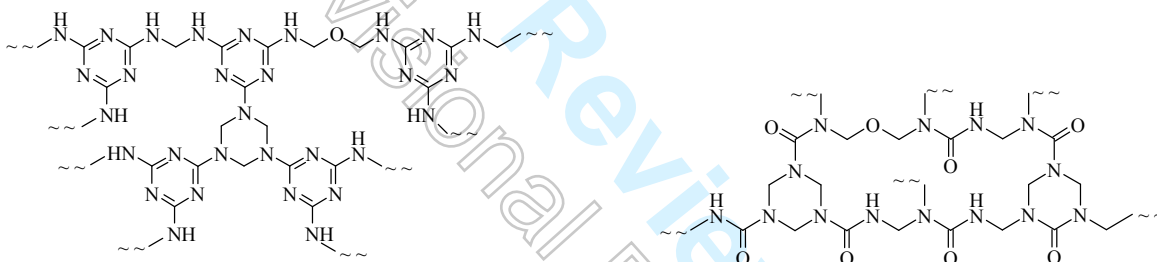
tetrakis(hydroxymethyl)urea



Examples of species present in an urea-formaldehyde resin

*Note 3:* Use of the term “resin“ (for the definition see ref. [17]) for cured reactive oligomers is discouraged, the cured resin should be named as an amino polymer.

*Note 4:* An amino polymer is usually a network polymer. To form the polymer, polycondensation takes place at the hydroxymethyl groups of an amino resin. Examples of the network-structure motifs of that form are:



Network structure motif of a melamine-formaldehyde polymer

Network structure motif of a urea-formaldehyde polymer

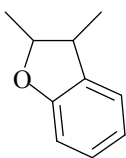
*Note 5:* Melamine polymers can be regarded as a subclass of *polytriazines*.

### 2.3 coumarone-indene polymer

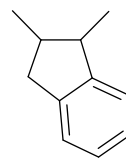
Polymer prepared from a mixture containing coumarone (benzofuran) and indene.

*Note 1:* A mixture of coal-tar and gas-tar distillates is commonly used to prepare a coumarone-indene polymer.

*Note 2:* A coumarone-indene polymer contains structural units such as:



coumarone unit



indene unit

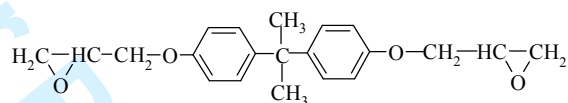
*Note 3.* Coumarone-indene polymers are film-forming materials.

*Note 4.* Coumarone-indene polymers are sometimes called *coumarone resins* or *coumarone-indene resins* [17]; use of these terms is discouraged.

## 2.4 epoxy polymer

Polymer prepared by reaction of compounds carrying two or more epoxy groups (reactive epoxides) with curing agents.

*Note 1:* The reactive epoxides are commonly prepared by condensation of epichlorohydrin [(chloromethyl)oxirane] with a di- or multi-functional acid, alcohol, amine, or phenol, most often with 4,4'-(propane-2,2-diyl)diphenol (bisphenol A) to give



2,2-bis[4-(2,3-epoxypropoxy)phenyl]propane

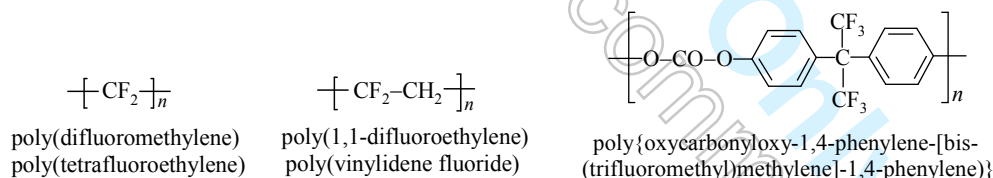
*Note 2:* The reactive epoxide is cured by reactions with a di- or higher-functional amine, carboxylic acid, anhydride, or dicyandiamide (e.g., cyanoguanidine).

*Note 3:* A reactive epoxide or a mixture of the reactive epoxides, and also its admixture with curing agent or agents, is usually referred to as an *epoxy resin* [17]. A use of the term epoxy resin for a cured epoxide is discouraged; it should be named “epoxy polymer“.

## 2.5 fluoropolymer

Polymer prepared from a fluorine-containing monomer.

*Note 1:* In a fluoropolymer, fluorine atoms can be linked either to main-chain carbon atoms such as in poly(tetrafluoroethylene) and poly(vinylidene fluoride), or to side-group carbon atoms such as in the polycarbonate derived from 4,4'-(hexafluoropropane-2,2-diyl)diphenol, (bisphenol AF).



*Note 2.* The term fluoropolymers can be generally regarded as a structure-based name indicating the presence of C-F bonds in constitutional units.

## 2.6 furan polymer

Polymers prepared from furan or a furan derivative.

*Note 1:* The most widely used furan polymers are linear, branched and network polymers prepared from (2-furyl)methanol, such as poly(furan-2,5-diylmethylene).

Note 2: Furan polymers prepared from furan-2-carbaldehyde (furfural), such as poly(furan-2,5-diylcarbonyl), are usually referred to as *furfural polymers*, and they are *conjugated polymers*.



poly(furan-2,5-diylmethylene)

poly(furan-2,5-diylcarbonyl)

Note 3: Branching and network formation can occur through the condensation of methylene groups with terminal  $-\text{CH}_2\text{OH}$  groups.

Note 4: Comonomers such as phenols, aldehydes, and ketones are often used in preparation of furan polymers.

Note 5: Use of term *furan resin* or *furfural resin* [17] for “furan polymer” or “furfural polymer” is discouraged.

## 2.7 phenolic polymer

Polymer prepared by the polycondensation of phenols and aldehydes or by curing reactive oligomers prepared from phenols and aldehydes.

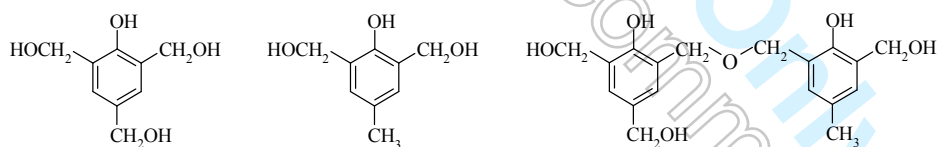
Note 1: A phenolic polymer is usually network polymer.

Note 2: Formaldehyde is commonly used as the aldehyde and (a) phenol itself or (b) a cresol is used as the phenol. *Phenol-formaldehyde polymer* is the phenolic polymer resulting from the reaction of phenol with formaldehyde.

Note 3: A mixture of the reactive oligomers prepared by the condensation of a phenol and aldehyde, and also its admixture with a curing agent, is usually referred to as *phenolic resin* or a *phenol-formaldehyde resin* [17].

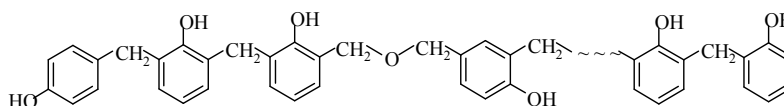
Note 4: Use of the term phenolic resin for cured reactive oligomers is discouraged, they should be named a “phenolic polymer”.

Note 5: A phenol-formaldehyde resin prepared under alkaline conditions with an aldehyde-to-phenol molar ratio between from 1.5 to 3 is known as a *resole*. A resole spontaneously undergoes polycondensation at hydroxymethyl groups, to give a network, phenol-formaldehyde polymer known as a *resite*.



Examples of constituents of resols

Note 6: A phenol-formaldehyde resin prepared under acidic conditions with a formaldehyde-to-phenol molar ratio less than one is known as a *novolak*. A novolak can be cured with formaldehyde or a multifunctional reagent such as 1,3,5,7-tetraazaadamantane (hexamethylenetetramine) to give a network, phenol-formaldehyde polymer.

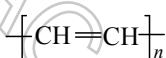


Structure motif of novolak

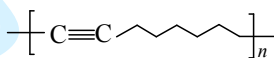
## 2.8 polyacetylene

Polymer prepared from acetylene (ethyne), a substituted acetylene, or both in admixture.

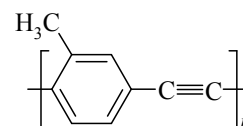
### Examples



poly(ethene-1,2-diyl)  
poly(vinylene)  
polyacetylene



poly(oct-1-yne-1,8-diyl)



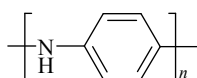
poly[(2-methyl-1,4-phenylene)-  
ethyne-1,2-diyl]

*Note 1:* A polymer of buta-1,3-diyne or a substituted buta-1,3-diyne, or both in admixture is referred to as *polydiacetylene* (see 2.13). Polydiacetylenes are a subclass of polyacetylenes.

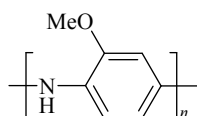
*Note 2:* A polyester, polyamide, polyurethane, for example, prepared from monomers with triple bond unsaturation such as from hexynedioic acid or but-2-yne-1,4-diol is excluded. Such polymer should be classified as an *unsaturated polyester*, *unsaturated polyamide*, or *unsaturated polyurethane*.

## 2.9 polyaniline

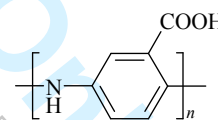
Polymer prepared exclusively from aniline, or a substituted aniline, or both in admixture.



poly(imino-1,4-phenylene)  
polyaniline



poly[imino(2-methoxy-1,4-phenylene)]  
poly(2-methoxyaniline)



poly[imino(3-carboxy-1,4-phenylene)]  
poly(3-carboxyaniline)

*Note 1:* Polyanilines are a subclass of *polyamines*. Partly oxidized polyanilines belong among *conjugated polymers*.

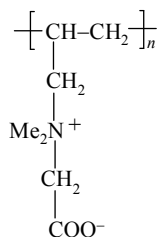
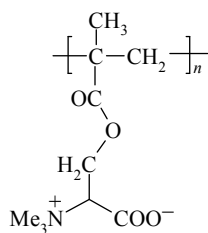
*Note 2:* A polycondensate of aniline and an aldehyde is excluded. It is an *aniline-aldehyde polymer*, a type of *amino polymers*.

## 2.10 polybetaine

Polymer prepared from a betaine, i.e., from a zwitterionic monomer containing a trialkylammonium group as the positively charged pole and carboxylate anion as the negatively charged pole.



## Examples

poly(*N*-allylbetaine)

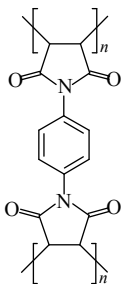
poly(betaine-2-ylmethylmethacrylate)

Note 1: Polybetaines are a subclass of *polyzwitterions*.

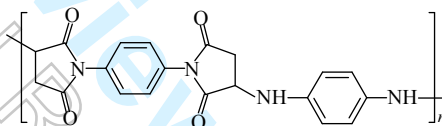
## 2.11 polybismaleimide

Polymer prepared from a bismaleimide.

## Examples



poly[1,4-bis(maleimido)phenylene]

poly(1,4-bismaleimidobenzene-*alt*-1,4-benzenediamine)

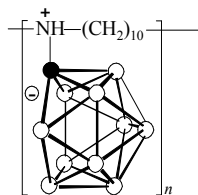
Note 1: Bismaleimides are usually copolymerized with diamines, dicyanates, or aromatic diallyl derivatives.

Note 2: A polybismaleimide is usually *branched polymer* or, upon curing, a *network polymer*.

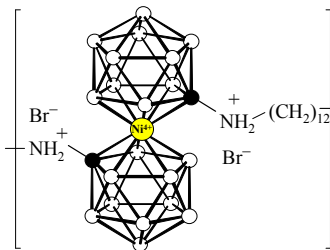
## 2.12 polycarborane

Polymer prepared from a carborane.

## Examples



poly{[(7-carba-*nido*-undecaborane(12)-7-yl)iminio]decane-1,10-diyl}

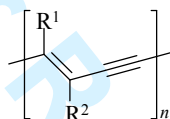


poly{iminio[bis(1,1'-monocarbollide)-nickelate(IV)-1,1'-diyl]iminiododecane-1,12-diyl dibromide}

*Note:* A polycarborane is usually an *ionic polymer*.

### 2.13 polydiacetylene

Polymer prepared from buta-1,3-diyne (diacetylene) or a substituted buta-1,3-diyne or both in admixture.

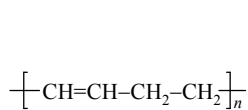


*Note:* Polydiacetylenes are a subclass of *conjugated polymers* as well as a subclass of *polyacetylenes*.

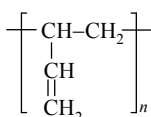
### 2.14 polydiene

Polymer prepared from a diene, or a substituted diene, or both in admixture.

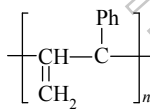
*Examples*



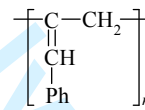
poly(but-1-ene-1,4-diyl)



poly(1-vinylethylene)



poly(1-methylidene-2-phenylethylene)



poly[1-(phenylmethylidene)ethylene]

*Note:* A polydiene prepared from propadiene (allene) or a substituted propadiene is usually referred to as a *polyallene* or a *polypropadiene* (see the last two examples).

### 2.15 polyolefin

Polymer prepared from an olefin (alkene).

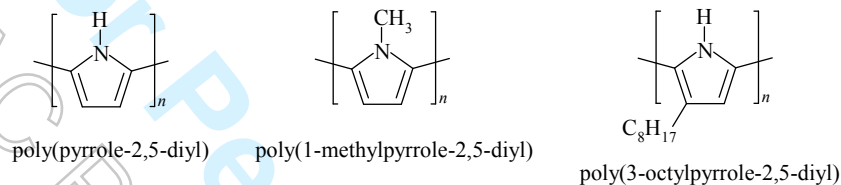
*Note 1:* A typical polyolefin macromolecule is described by the monomeric unit:  $-\text{CR}^1\text{R}^2-\text{CH}_2-$ , where  $\text{R}^1$  and  $\text{R}^2$  are hydrogen, alkyl, or cycloalkyl; polyolefins with 1,2-disubstituted monomeric units  $-\text{CHR}^1-\text{CHR}^2-$  are rather rare, owing to low thermodynamic stability of their main chains caused by steric effects of the substituents.

*Note 2:* The structure-based name of a polyolefin is a *polyalkylene*.

## 2.16 polypyrrole

Polymer prepared from pyrrole, or a substituted pyrrole or both in admixture.

*Examples*



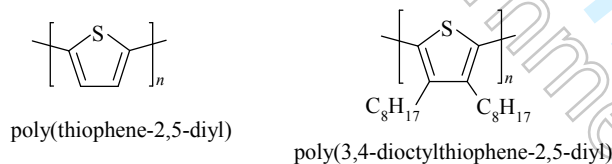
*Note 1:* An ideal polypyrrole molecule contains exclusively pyrrole-2,5-diyl monomeric units.

*Note 2:* Polypyrroles are a subclass of *conjugated polymers*.

*Note 3:* The term “polypyrrole” can be generally regarded as a structure-based name, indicating the presence of pyrrole constitutional units in the main chain.

## 2.17 polythiophene

Polymer prepared from thiophene, or a substituted thiophene, or both in admixture.



*Note 1:* An ideal polythiophene molecule contains exclusively thiophene-2,5-diyl monomeric units.

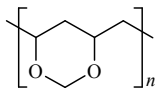
*Note 2:* Polythiophenes are a subclass of *conjugated polymers*.

*Note 3:* The term “polythiophene” can be generally regarded as a structure-based name, indicating the presence of thiophene constitutional units in the main chain.

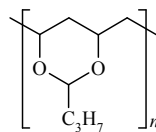
## 2.18 polyvinyl acetal

Polymer prepared by acetalization of poly(vinyl alcohol) with an aldehyde.

*Examples*



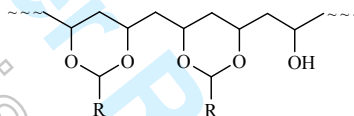
poly[(1,3-dioxane-4,6-diyl)methylene]  
polyvinyl formal



poly[(2-propyl-1,3-dioxane-4,6-diyl)methylene]  
polyvinyl butyral

*Note 1:* The name “polyvinyl acetal” is derived using both source-based and structure-based principles: “polyvinyl” comes from the source polymer: poly(vinyl alcohol), and “acetal” indicates the structure of constitutional units that are present in the resulting modified polymer.

*Note 2:* A common polyvinyl acetal has not the ideal structure shown above but it also contains a low fraction of unreacted hydroxyl groups.

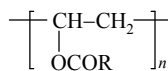


polyvinyl acetal

## 2.19 polyvinyl ester

Polymer prepared from a vinyl ester.

*Note 1:* A molecule of a regular polyvinyl ester is described by the constitutional repeating unit:



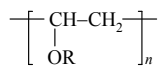
where R is alkyl, aryl or heteroaryl or substituted alkyl, substituted aryl or substituted heteroaryl.

*Note 2:* Polyvinyl esters are a subclass of *vinyl polymers*.

## 2.20 polyvinyl ether

Polymer prepared from a vinyl ether.

*Note 1:* A molecule of a regular polyvinyl ether is described by the constitutional repeating unit:



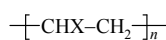
where R is alkyl, aryl or heteroaryl or substituted alkyl, substituted aryl or substituted heteroaryl.

*Note 2:* Polyvinyl ethers are a subclass of *vinyl polymers*.

## 2.21 polyvinyl halide

Polymer prepared from a vinyl halide (monohalogenoethene).

*Note 1:* A molecule of a regular polyvinyl halide is described by the constitutional repeating unit:



where X is F, Cl, Br or I.

*Note 2:* Polyvinyl halides are a subclass of *vinyl polymers*.

## 2.22 polyvinyl ketone

Polymer prepared from a vinyl ketone.

*Note 1:* A molecule of a regular polyvinyl ketone is described by the constitutional repeating unit:

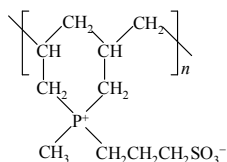


where R is alkyl, aryl or heteroaryl or substituted alkyl, substituted aryl or substituted heteroaryl.

*Note 2:* Polyvinyl ketones are a subclass of *vinyl polymers*.

## 2.23 polyzwitterion zwitterionic polymer polyamphion poly(inner salt)

Polymer prepared by polymerization of a zwitterionic monomer.

*Example*

poly{[*P*-methyl-*P*-(3-sulfonatepropyl)-phosphacyclohexane-3,5-diyl]methylene}

*Note 1:* In a common polyzwitterion, zwitterionic groups are usually located in pendent groups. Such polyzwitterion is a type of polyelectrolytes.

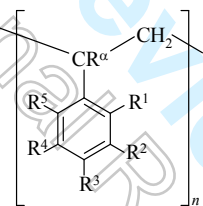
*Note 2:* *Polybetaines* are a subclass of polyzwitterions.

*Note 3:* Unlike a *polyampholyte*, a zwitterionic polymer contains both anion and cation in the same monomeric unit.

## 2.24 styrene polymer polystyrene

Polymer prepared from styrene, or a substituted styrene, or both in admixture.

*Note 1:* Macromolecule of a regular styrene homopolymer is described by the constitutional repeating unit:



where  $R^\alpha$  and  $R^1$  to  $R^5$  are each H, alkyl, aryl, or heteroaryl.

*Note 2:* Styrene polymers are a subclass of *vinyl polymers*.

## 2.25 vinyl polymer

Polymer prepared from a monomer containing vinyl group  $-\text{CH}=\text{CH}_2$ .

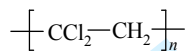
*Note 1:* Macromolecule of a regular vinyl homopolymer is described by the constitutional repeating unit:  $-\text{CHR}-\text{CH}_2-$ , where R is alkyl, aryl, heteroaryl, halogen, or a heteroatom containing pendent group.

*Note 2:* *Acrylic polymers*, *polyolefins*, *polyvinyl acetals*, *polyvinyl esters*, *polyvinyl ethers*, *polyvinyl halides*, *polyvinyl ketones* and *styrene polymers* are subclasses of *vinyl polymers*.

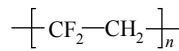
## 2.26 vinylidene polymer

Polymer prepared from a monomer containing vinylidene (ethene-1,1-diyl) group  $>C=CH_2$ .

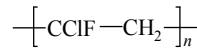
*Note:* Macromolecule of a regular vinylidene polymer is described by the constitutional repeating unit:  $-CR^1R^2-CH_2-$ , where  $R^1$  and  $R^2$  are each alkyl, aryl, heteroaryl or halogen, such as by the units:



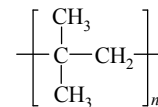
poly(1,1-dichloroethylene)  
poly(vinylidene chloride)



poly(1,1-difluoroethylene)  
poly(vinylidene fluoride)



poly(1-chloro-1-fluoroethylene)

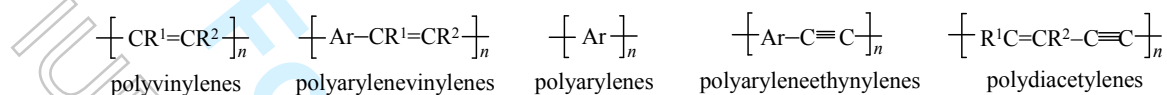


poly(1,1-dimethylethylene)  
polyisobutylene

### 3. CLASS NAMES BASED ON CHEMICAL STRUCTURE

#### 3.1 conjugated polymer

Polymer composed of macromolecules with main chains consisting of a sequence of conjugated multiple bonds:



where  $\text{R}^1$  and  $\text{R}^2$  are each hydrogen, alkyl, aryl or heteroaryl and Ar is arylene or heteroarylene.

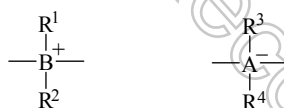
*Note 1:* A conjugated polymer in molecules of which  $\pi$ -electrons are delocalized along main chain is referred to as the  $\pi$ -conjugated polymer. *Polyacetylene*, *polypyrrole* or *polythiophene* are examples of  $\pi$ -conjugated polymers.

*Note 2:* A conjugated polymer in molecules of which  $\sigma$ -electrons are delocalized along main chain is referred to as the  $\sigma$ -conjugated polymer. *Polysilanes* and *polygermanes* are examples of  $\sigma$ -conjugated polymers.

*Note 3:* *Polyanilines*, *polyaryleneethynylenes*, *polyarylenes*, *polyarylenevinylenes*, *polydiacetylenes*, *polygermanes*, *polyphenylenes*, *polyphenyleneethynylenes*, *polyphenylenevinylenes*, *polypyrroles*, *polysilanes*, *polythiophenes*, and *polyvinylenes* are examples of subclasses of conjugated polymers.

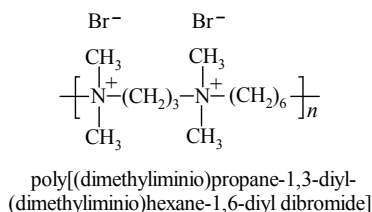
#### 3.2 ionene

Polymer composed of macromolecules containing charged atoms in the backbone:



where  $\text{B}^+$  is a positively charged atom,  $\text{A}^-$  is a negatively charged atom,  $\text{R}^1$  and  $\text{R}^2$  are each hydrogen, alkyl, aryl, heteroaryl or aralkyl, and  $\text{R}^3$  and  $\text{R}^4$  are each aryl, heteroaryl or another electron-withdrawing group.

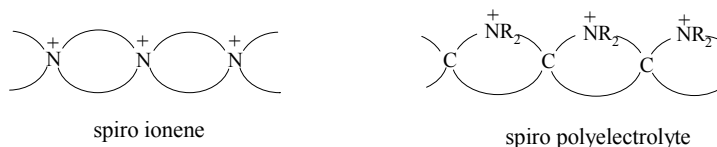
*Note 1:* Nitrogen or phosphorus atoms are positively charged main-chain atoms in a common ionene.



*Note 2:* Ionenes are a subclass of *ionic polymers*.



Note 3: An ionic *spiro polymer* is the ionene only if all strands of its macromolecules include all charged atoms. Polymers failing to meet this criterion are *spiro polyelectrolytes*.



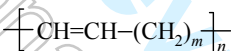
### 3.3 ionic polymer ion-containing polymer

Polymer composed of macromolecules containing ionic groups irrespective of their nature, content, and location.

Note: Ionic polymers are more in detailed classified according to the nature, content, and location of ionic groups in their macromolecules. Those with clearly defined structure are included in this document: *ionene*, *polybetaine*, or *polyzwitterion*; those, for definition of which also content of ionic groups is important (*ionomer*”, *polyampholyte*”, *polyelectrolyte*”, and others) are defined elsewhere [18].

### 3.4 polyalkenylene

Polymer composed of macromolecules containing exclusively alkenylene (alkene- $\alpha,\omega$ -diyl) constitutional repeating units:



Note 1: Polyalkenylenes are sometimes referred to as a *polyalkenamers*; use of this term is discouraged.

Note 2: *Polyvinylenes* ( $m = 0$ ) are excluded.

### 3.5 polyalkylene

Polymer composed of macromolecules containing exclusively alkylene constitutional repeating units:

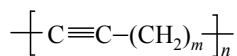


where  $\text{R}^1$  and  $\text{R}^2$  are each hydrogen, alkyl, or cycloalkyl.

Note: *Polyolefins* are the most common polyalkylenes.

### 3.6 polyalkynylene

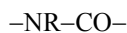
Polymer composed of macromolecules containing exclusively alkynylene constitutional units:



*Note:* Poly(oct-1-yne-1,8-diyl) (see 2.8) is an example of polyalkynylene.

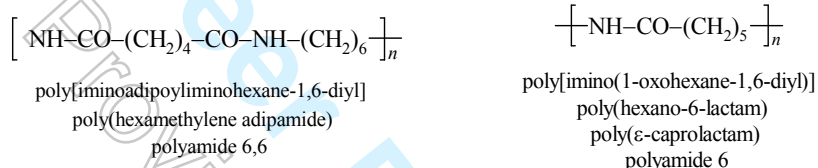
### 3.7 polyamide

Polymer composed of macromolecules containing carboxamide groups as linkages in the backbone:

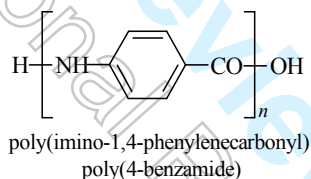


where R is hydrogen, alkyl, aryl, or heteroaryl.

*Note 1:* A polyamide containing, besides  $-\text{NR}-\text{CO}-$  linkages, exclusively aliphatic constitutional units is an *aliphatic polyamide*; examples are:



*Note 2:* A polyamide containing, besides  $-\text{NR}-\text{CO}-$  linkages, exclusively aromatic constitutional units is an *aromatic polyamide* commonly referred to as an *aramide*; example is:

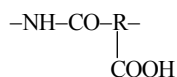


*Note 3:* A polyamide containing carboxylic pendent groups is a *polyamide acid* commonly referred to as a *polyamic acid* (see 3.8).

*Note 4:* A polymer containing only pendent amide groups is excluded, e.g., polyacrylamide.

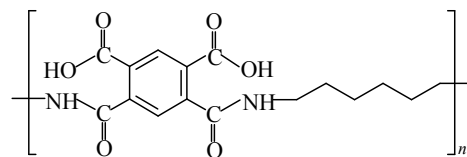
### 3.8 polyamide acid polyamic acid

Polyamide containing pendent carboxylic acid groups:



where R is a constitutional unit with a connectivity three or higher.

*Note:* A polyamide acid is mostly prepared as a processable precursor giving a polyimide upon thermal curing. Polyamide acid prepared from benzene-1,2:4,5-tetracarboxylic dianhydride (pyromellitic anhydride) and hexane-1,6-diamine (hexamethylenediamine) is an example of such precursor:



poly[iminocarbonyl(4,6-dicarboxy-1,3-phenylene)carbonylimino]hexane-1,6-diyl  
(one of two possible structures)

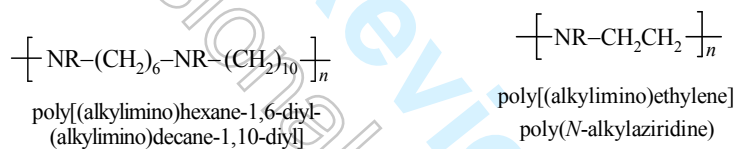
### 3.9 polyamine

Polymer composed of macromolecules containing imino groups as linkages in the backbone:



where R is hydrogen, alkyl, aryl, or heteroaryl.

*Note 1:* Examples of polyamines are:

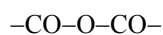


*Note 2:* A polymer containing only pendent amino groups is excluded. However, in organic chemistry, low-molecular-weight compounds containing two or more amino groups are also called polyamines.

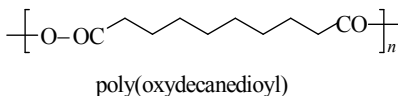
*Note 3:* Quaternized polyamines have iminio linkages,  $-\text{N}^+\text{R}^1\text{R}^2-$ , in the backbone ( $\text{R}^1$  and  $\text{R}^2$  are each hydrogen, or an alkyl, aryl or heteroaryl group) and they are a structure-based subclass of *ionenes* (see 3.3).

### 3.10 polyanhydride

Polymer composed of macromolecules containing carboxylic acid anhydride groupings as linkages in the backbone:

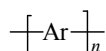


*Note:* An example of a polyanhydride is:



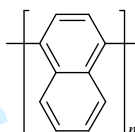
### 3.11 polyarylene

Polymer composed of macromolecules containing exclusively arylene or heteroarylene units in the backbone:



where Ar is a divalent arylene or heteroarylene group.

*Note 1:* An example of a polyarylene is:



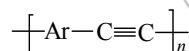
poly(naphthalene-1,4-diyl)

*Note 2:* Polyarylenes are a structure-based subclass of *conjugated polymers*.

*Note 3:* *Polyphenylenes* (Ar is phenylene or substituted phenylene) are a subclass of polyarylenes.

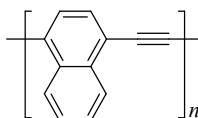
### 3.12 polyaryleneethynylene

Polymer composed of macromolecules containing exclusively alternating arylene and ethynylene (ethynediyl) constitutional repeating units in the backbone:



where Ar is a divalent arylene or heteroarylene group.

*Note 1:* An example of a polyaryleneethynylene is:



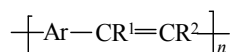
poly[naphthalene-1,4-diylethynediyl]

*Note 2:* Polyaryleneethynylenes are a subclass of *conjugated polymers*.

Note 3: A polymer for which Ar is phenylene is a *polyphenyleneethynylene*.

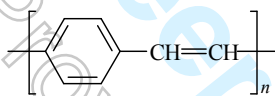
### 3.13 polyarylenevinylene

Polymer composed of macromolecules containing exclusively alternating arylene and vinylene (ethene-1,2-diyl) or substituted vinylene constitutional repeating units in the backbone:

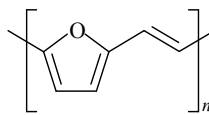


where Ar is a divalent arylene or heteroarylene group and R<sup>1</sup> and R<sup>2</sup> are each hydrogen, or an alkyl, aryl or heteroaryl group.

Note 1: Examples of a polyaryleneethynylene are:



poly(1,4-phenyleneethene-1,2-diyl)  
poly(1,4-phenylenevinylene)



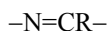
poly(furan-2,5-diylethene-1,2-diyl)  
poly(furan-2,5-diyvinylene)

Note 2: Polyarylenevinylenes are a subclass of *conjugated polymers*.

Note 3: *Polyphenylenevinylenes* (Ar is phenylene or substituted phenylene) are a subclass of polyarylenevinylenes.

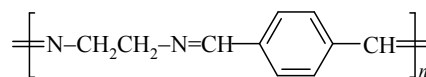
### 3.14 polyazomethine polyazine poly(Schiff base)

Polymer composed of macromolecules containing azomethine linkages in the backbone:



where R is hydrogen, or an alkyl or aryl group.

Note 1: An example of a polyazomethine is:

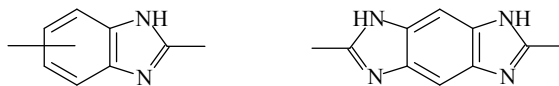


poly(nitriloethylenenitrimethine-1,4-phenylenemethine)  
poly(nitriloethylenenitrimethanylylidene-1,4-phenylenemethanylylidene)

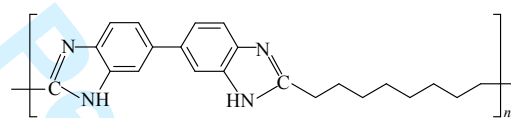
Note 2: A polymer with only pendent azomethine groups is excluded.

### 3.15 polybenzimidazole

Polymer composed of macromolecules containing benzimidazole groups in the backbone, such as groups:



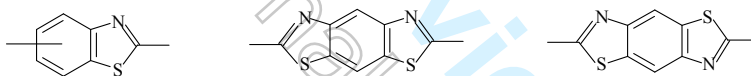
Note: An example of a polybenzimidazole is:



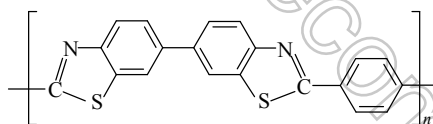
poly[(5,5'-bibenzimidazole)-2,2'-diyloctane-1,8-diyl]

### 3.16 polybenzothiazole

Polymer composed of macromolecules containing benzothiazole group in the backbone, such as groups:



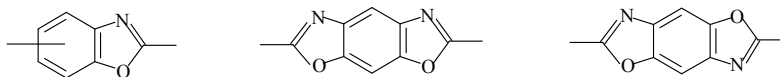
Note: An example of a polybenzothiazole is:



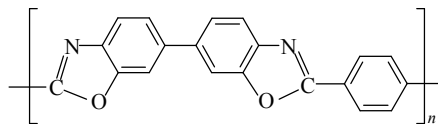
poly[(6,6'-bibenzothiazole)-2,2'-diyl-1,4-phenylene]

### 3.17 polybenzoxazole

Polymer composed of macromolecules containing benzoxazole linkages in the backbone, such as linkages:



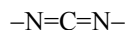
Note: An example of a polybenzoxazole is:



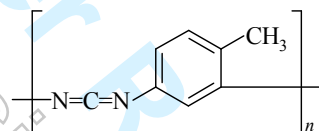
poly[(6,6'-bibenzoxazole)-2,2'-diyl-1,4-phenylene]

### 3.18 polycarbodiimide

Polymer composed of macromolecules containing carbodiimide linkages in the backbone:



Note 1: An example of a polycarbodiimide is:



poly[nitrilo(methanedilydene)nitrilo-(4-methyl-1,3-phenylene)]

poly(carbodiimide-4-methyl-1,3-phenylene)

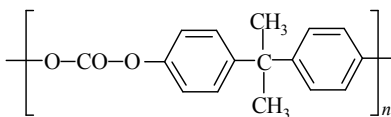
Note 1: A polymer containing only pendent carbodiimide linkages is excluded.

### 3.19 polycarbonate

Polymer composed of macromolecules containing carbonate linkages in the backbone:



Note 1: An example of a polycarbonate is:



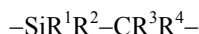
poly[oxycarbonyloxy-1,4-phenylene-(dimethylmethylene)-1,4-phenylene]

poly(bisphenol A carbonate)

Note 2: A polymer containing only pendent carbonate linkages is excluded.

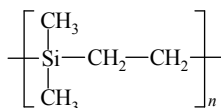
### 3.20 polycarbosilane

Polymer composed of macromolecules containing carbon-silicon linkages in the backbone:



where  $\text{R}^1$ ,  $\text{R}^2$ ,  $\text{R}^3$ , and  $\text{R}^4$  are each hydrogen, alkyl, aryl, or heteroaryl.

Note 1: An example of a polycarbosilane is:

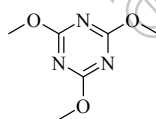


poly[(dimethylsilanediy)ethylene]

Note 2: A polycarbosilane containing, in addition to silanediyl groups, exclusively alkylene or substituted alkylene units is referred to as a *polysilalkylene*, whereas that involving exclusively arylene units is referred to as a *polysilarylene*.

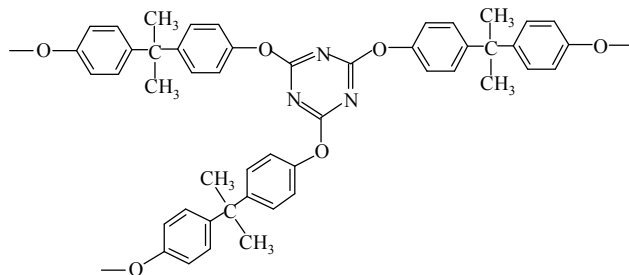
### 3.21 polycyanurate

Polymer composed of macromolecules containing 1,3,5-triazine-2,4,6-triyltrioxy constitutional units (cyanurate groups) in the backbone:



Note 1: An example of structure of a polycyanurate is:





Structure motif of a polycyanurate prepared from  
2,2-bis(4-cyanatophenyl)propane (bisphenol A dicyanate)

*Note 2:* Polycyanurates are isomeric with *polyisocyanurates*.

*Note 3:* Polycyanurates can be regarded as a subclass of *polytriazines*.

### 3.22 polyester

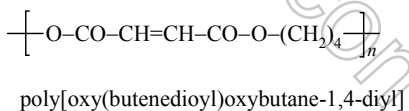
Polymer composed of macromolecules containing carboxylic ester linkages in the backbone:



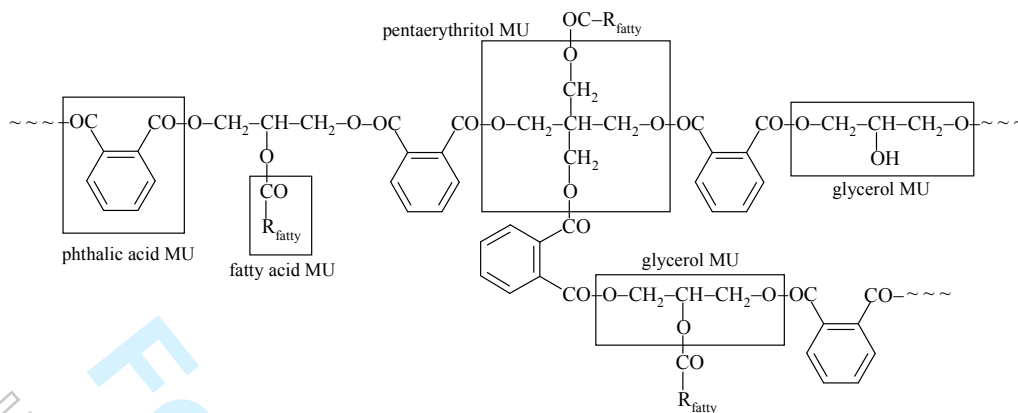
*Note 1:* Examples of polyesters are:



*Note 2:* A polyester comprising unsaturated constitutional units such as a polyester prepared from maleic anhydride or from but-2-yne-1,4-diol is referred to as the *unsaturated polyester*.



*Note 3:* A polyester prepared from a polyol (typically a triol or tetraol), and a mixture of carboxylic acid anhydrides and fatty acids (e.g., linseed oil or tall oil) is referred to as an *alkyd polymer* or *alkyd*. Structure motifs of an *alkyd polymer* prepared from phthalic anhydride, glycerol, pentaerythritol, and fatty acids are shown below (MU stands for monomeric unit):



Note 4: Polycarbonates, polythioesters and unsaturated polyesters are subclasses of polyesters.

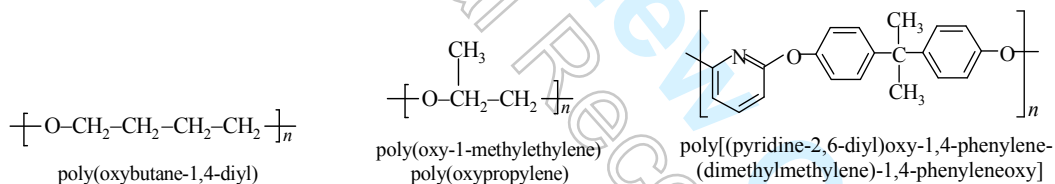
Note 5: A polymer containing only pendent ester groups is excluded, for example, a methacrylic polymer.

### 3.23 polyether

Polymer composed of macromolecules containing ether linkages in the backbone:



Note 1: Examples of polyethers are:



Note 2: Polyoxyalkylenes and polyoxyarylenes are subclasses of polyethers.

Note 3: A polymer containing only pendent ether groups is excluded.

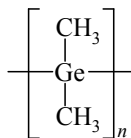
### 3.24 polygermane

Polymer composed of macromolecules containing exclusively germanium atoms in the backbone:



where R is alkyl, aryl or heteroaryl.

Note 1: An example of a polygermane is:

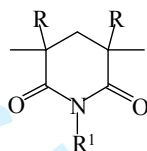


poly(dimethylgermanediyl)

Note 2: Polygermanes are sometimes referred to as *polygermylenes*. Use of this term is discouraged.

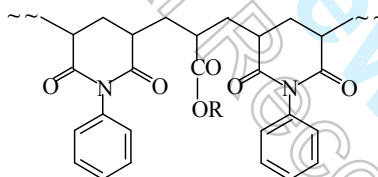
### 3.25 polyglutarimide

Polymer composed of macromolecules containing glutarimide rings in the backbone:



where R is hydrogen or alkyl (usually methyl) and R<sup>1</sup> is hydrogen, or an alkyl, aryl or heteroaryl group.

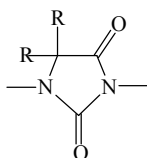
Note: A polyglutarimide is commonly prepared by modification of a poly(alkyl acrylate) with an amine, such as aniline, so it also contains residual acrylic units:



Structure motives of a polyglutarimide prepared from poly(alkyl acrylate) and aniline

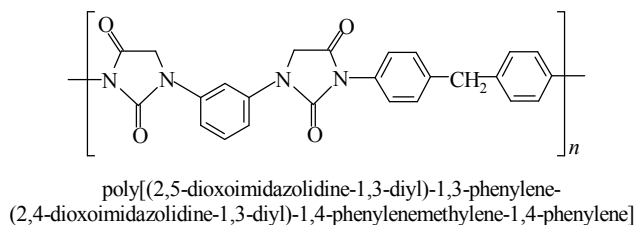
### 3.26 polyhydantoin

Polymer composed of macromolecules containing hydantoin (imidazolidine-2,4-dione) rings in the backbone:



where R is hydrogen, or an alkyl, aryl or heteroaryl group.

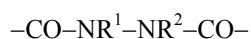
Note 1: An example of a polyhydantoin is:



Note 2: Polyhydantoin is a subclass of *polyimides*.

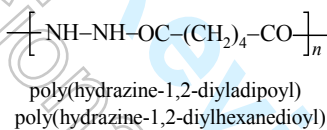
### 3.27 polyhydrazide

Polymer composed of macromolecules containing hydrazide linkages in the backbone:



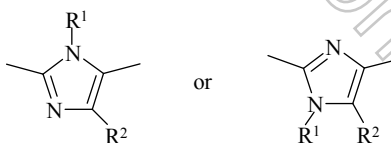
where  $\text{R}^1$  and  $\text{R}^2$  are each hydrogen, alkyl, aryl, or heteroaryl.

Note: An example of a polyhydrazide is:



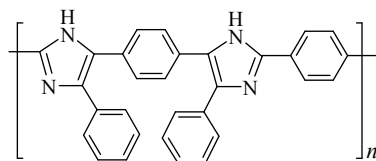
### 3.28 polyimidazole

Polymer composed of macromolecules containing imidazole rings in the backbone:



where  $\text{R}^1$  and  $\text{R}^2$  are each hydrogen, or an alkyl or aryl group.

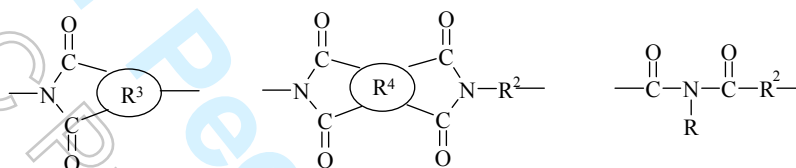
Note: An example of a polyimidazole is:



poly[(4-phenylimidazole-2,5-diyl)-1,4-phenylene-(4-phenylimidazole-5,2-diyl)-1,4-phenylene]

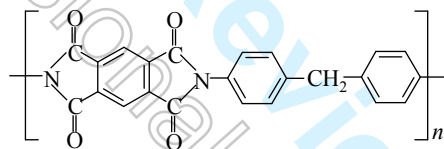
### 3.29 polyimide

Polymer composed of macromolecules containing cyclic dicarboximide groupings in the backbone:



where R, R<sup>2</sup>, R<sup>3</sup> and R<sup>4</sup> are groups with connectivity one, two, three, and four, respectively.

*Note 3:* An example of a polyimide is:

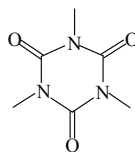


poly[(2,3,6,7-tetrahydro-1,3,5,7-tetraoxo-1*H*,5*H*-benzo[1,2-*c*:4,5-*c'*]-dipyrrole-2,6-diyl)-1,4-phenylenemethylene-1,4-phenylene]  
poly(diphenylmethane-4,4'-diylpyromellitimide)

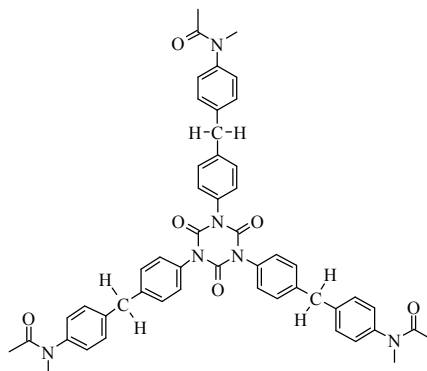
*Note 2:* A polymer containing only pendent dicarboximide groups is excluded.

### 3.30 polyisocyanurate

Polymer composed of macromolecules containing 1,3,5-triazine-2,4,6-trione (isocyanurate) rings in the backbone:



Note 1: An example of structure motifs of a polyisocyanurate is shown below:



Structure motifs of a polyisocyanurate

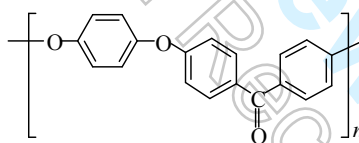
Note 2: Polyisocyanurates are isomeric with *polycyanurates*.

### 3.31 polyketone

Polymer composed of macromolecules containing keto groups as linkages in the backbone:



Note 1: A polyketone containing in addition to keto groups also ether linkages in the main chains is usually referred to as a *polyetherketone*.

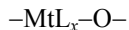


poly(oxy-1,4-phenyleneoxy-1,4-phenylene-carbonyl-1,4-phenylene)

Note 2: A polymer containing only pendent keto groups, such as a polyvinyl ketone, as well as a polymer containing main-chain carbonyl groups directly linked to a main-chain heteroatom, such as a *polyester* and or a *polyamide*, is excluded.

### 3.32 polymetalloxane

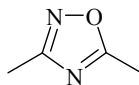
Organometallic polymer composed of macromolecules containing exclusively alternating metal and oxygen atoms in the main chain:



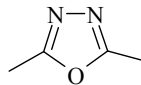
where Mt is a metal atom such as Al, Ge, Sn, or Ti, and L is a metal-bonded organic substituent (ligand).

### 3.33 polyoxadiazole

Polymer composed of macromolecules containing 1,2,4- or 1,3,4-oxadiazole rings in the backbone:



1,2,4-oxadiazole-3,5-diyl

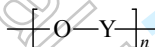


1,3,4-oxadiazole-2,5-diyl

*Note:* Poly(1,3,4-oxadiazole-2,diyl) is a *conjugated polymer*.

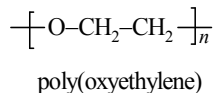
### 3.34 polyoxyalkylene

Polymer composed of macromolecules containing exclusively oxyalkylene constitutional units in the backbone:



where Y is an alkylene or substituted alkylene group contributing at least two carbon atoms to the main chain.

*Note 1:* An example of a polyoxyalkylene is:

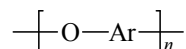


*Note 2:* A polyoxyalkenylene for which Y is  $-\text{CR}_2-$  (R = H, alkyl, aryl, etc.) is a *polyoxymethylene* (see 3.37).

*Note 3:* Polyoxyalkylenes are a subclass of *polyethers*.

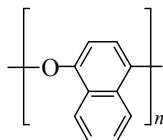
### 3.35 polyoxyarylene

Polymer composed of macromolecules containing exclusively oxyarylene constitutional repeating units in the backbone:



where Ar is an arylene, heteroarylene, substituted arylene or substituted heteroarylene.

*Note 1:* An example of polyoxyarylene is:



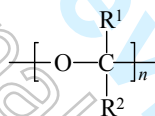
poly(oxynaphthalene-1,4-diyl)

*Note 2:* Polyoxyarylenes are a subclass of *polyethers*.

*Note 3:* A polyoxyarylene in which arylene is phenylene or a substituted phenylene is a *polyoxyphenylene*.

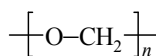
### 3.36 polyoxymethylene

Polymer composed of macromolecules containing exclusively oxymethylene or substituted oxymethylene repeating units in the backbone:

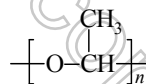


where R<sup>1</sup> and R<sup>2</sup> are each hydrogen, alkyl, aryl or heteroaryl.

*Note 1:* Examples of polyoxymethylenes are:



poly(oxymethylene)  
polyformaldehyde



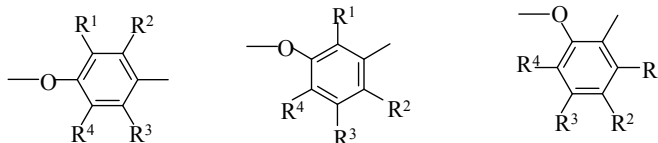
poly(oxymethylmethylene)  
polyacetaldehyde

*Note 2:* A polyoxymethylene is also referred to as a *polyacetal*, *polyketal* or *acetal resin*. Use of the last term is discouraged.

### 3.37 polyoxyphenylene

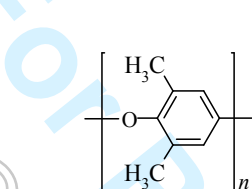
Polymer composed of macromolecules containing exclusively oxyphenylene or ring-substituted oxyphenylene repeating units in the backbone:



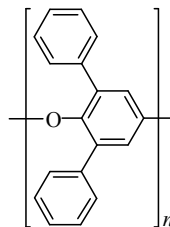


where  $R^1$ ,  $R^2$ ,  $R^3$ , and  $R^4$  are each hydrogen or an alkyl, aryl, or aralkyl group.

*Note 1:* Examples of a polyoxyphenylene are:



poly[oxy(2,6-dimethyl-1,4-phenylene)]

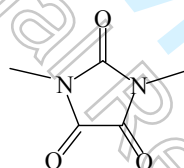


poly[oxy(2,6-diphenyl-1,4-phenylene)]

*Note 2:* Polyoxyphenylenes are a subclass of *polyoxyarylenes* as well as a subclass of *polyethers*.

### 3.38 polyparabanic acid

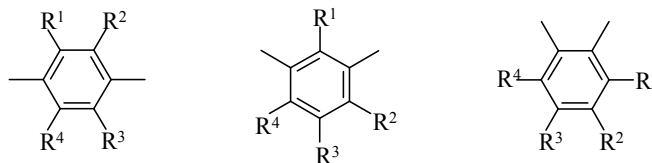
Polymer composed of macromolecules containing imidazolidinetrione (parabanic acid) rings in the backbone:



*Note:* Polyparabanic acids are a subclass of *polyimides*.

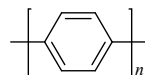
### 3.39 polyphenylene

Polymer composed of macromolecules containing exclusively  $\sigma$ -bonded benzene or substituted benzene rings in the backbone:



where  $R^1$ ,  $R^2$ ,  $R^3$ , and  $R^4$  are each hydrogen or a monovalent group.

Note 1: An example of polyphenylene is:

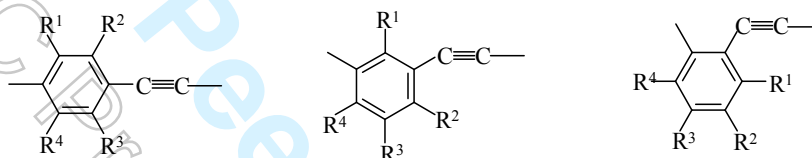


poly(1,4-phenylene)

Note 2: Polyphenylenes are a subclass of *polyarylenes* and a subclass of *conjugated polymers*.

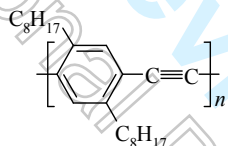
### 3.40 polyphenyleneethynylene

Polymer composed of macromolecules containing exclusively alternating phenylene or substituted phenylene and ethynylene (i.e., ethynediyl) constitutional units in the backbone:



where  $R^1$ ,  $R^2$ ,  $R^3$ , and  $R^4$  are each hydrogen, alkyl, aryl, halogen, trialkylsilyl etc.

Note 1: An example of polyphenyleneethynylene is:

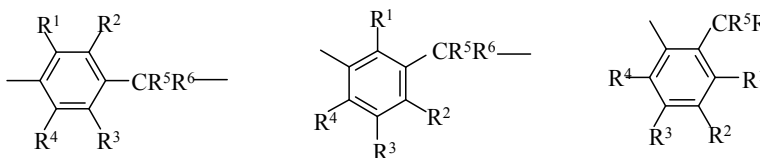


poly[(2,5-dioctyl-1,4-phenylene)ethynediyl]

Note 2: Polyphenyleneethynylenes are a subclass of *conjugated polymers* as well as a subclass of *polyaryleneethynylenes*.

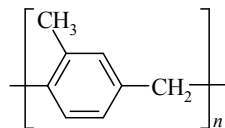
### 3.41 polyphenylenemethylene

Polymer composed of macromolecules containing exclusively alternating phenylene or substituted phenylene and methylene or substituted methylene constitutional units in the backbone:



where  $R^1$ ,  $R^2$ ,  $R^3$ ,  $R^4$ ,  $R^5$  and  $R^6$  are each hydrogen, alkyl, aryl, halogen, trialkylsilyl, etc.

Note 1: An example of polyphenylenemethylene is:

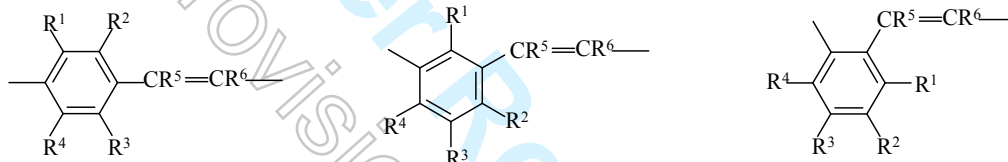


poly[(2-methyl-1,4-phenylene)methylene]

Note 2: Polyphenylenemethylenes are also referred to as *polybenzyls*.

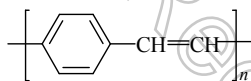
### 3.42 polyphenylenevinylene

Polymer composed of macromolecules containing exclusively alternating phenylene or substituted phenylene and vinylene or substituted vinylene constitutional units in the backbone:



where  $R^1$ ,  $R^2$ ,  $R^3$ ,  $R^4$ ,  $R^5$  and  $R^6$  are each hydrogen, alkyl, aryl, heteroaryl, halogen, trialkylsilyl, etc.

Note 1: An example of polyphenylenevinylene is:



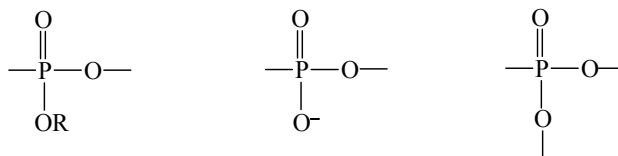
poly(1,4-phenyleneethene-1,2-diyl)  
poly(1,4-phenylenevinylene)

Note 2: Polyphenylenevinylenes are *conjugated polymers*.

Note 3: Polyphenylenevinylenes are a subclass of *polyarylenevinylenes*.

### 3.43 polyphosphate

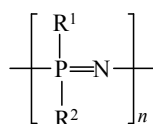
Polymer composed of macromolecules containing phosphate repeating units:



where R is hydrogen, alkyl, aryl, or heteroaryl.

### 3.44 polyphosphazene

Polymer composed of macromolecules containing exclusively phosphazene repeating units in the backbone:



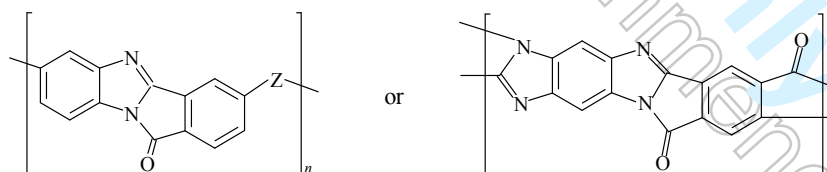
where R<sup>1</sup> and R<sup>2</sup> are each a monovalent group, such as a halogen or an alkoxy group.

*Note:* Examples of polyphosphazene are:



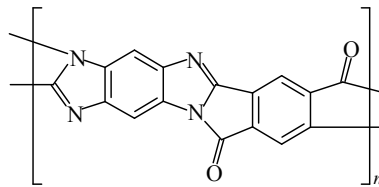
### 3.45 polypyrrone

Polymer composed of *single strand* or *ladder* macromolecules comprising pyrnone (isoindolo[2,1-*a*]benzimidazole) repeating units such as:



where Z is a divalent linking group or atom.

*Note 1:* An example of polypyrrone is:



poly(10-oxo-3,10-dihydroimidazo[4',5'']benzo[4,5]imidazo[2,1-a]isoindole-2,3,8-triyl-7-carbonyl)

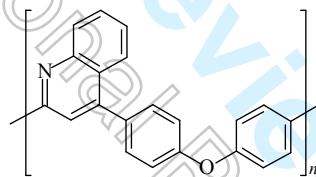
Note 2: Polypyrrones are also referred to as *polybenzimidazobenzophenanthrolines*, *polybenzimidazolimides*, *polybenzimidazolones*, *polybenzimidazopyrrolones*, *polybenzoylenebenzimidazoles*, *polyimidazopyrrolones*, and *polyisoindolobenzimidazoles*.

### 3.46 polyquinoline

Polymer composed of macromolecules containing quinoline moieties in the backbone:



Note: An example of polyquinoline is:



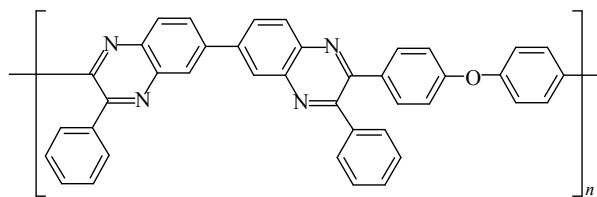
poly(quinoline-2,4-diyl-1,4-phenyleneoxy-1,4-phenylene)

### 3.47 polyquinoxaline

Polymer composed of macromolecules containing quinoxaline groups in the backbone:



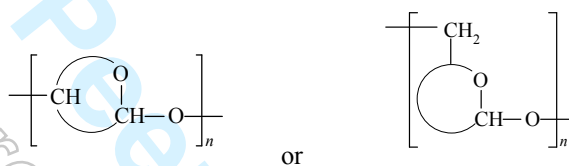
Note: An example of polyquinoline is:



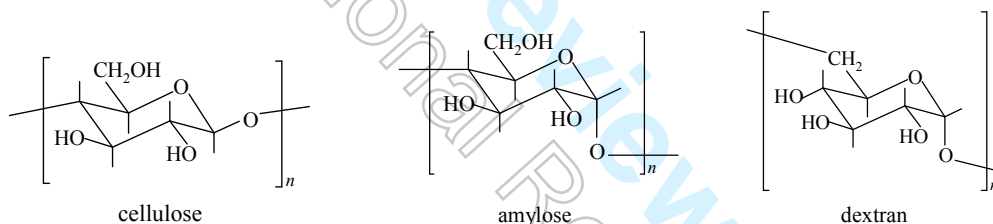
poly[(3,3'-diphenyl[6,6'-biquinoxaline]-2,2'-diyl)-1,4-phenyleneoxy-1,4-phenylene]

### 3.48 polysaccharide

Polymer composed of macromolecules containing in the backbone exclusively monosaccharide rings or chemically modified monosaccharide rings linked through glycosidic (acetal) bonds.



*Note:* The most important polysaccharides – *cellulose*, *glycogen*, *amylose*, *dextran*, and *amylopectin* – are derived from D-glucose:



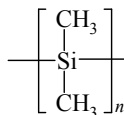
### 3.49 polysilane

Polymer composed of macromolecules containing exclusively silicon atoms in the backbone:



where R<sup>1</sup> and R<sup>2</sup> are each hydrogen or an alkyl, aryl or heteroaryl group.

*Note 1:* An example of polysilane is:



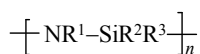
poly(dimethylsilanediyl)

Note 2: Polysilanes are often referred to as *polysilylenes*. Use of this term is discouraged.

Note 3: Polysilanes are  $\sigma$ -conjugated polymers.

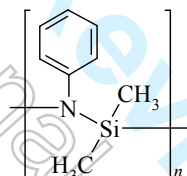
### 3.50 polysilazane

Polymer composed of macromolecules containing exclusively alternating nitrogen and silicon atoms in the backbone:



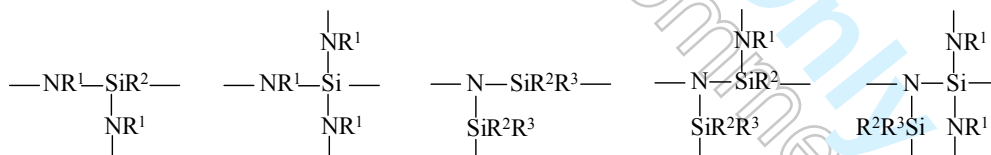
where  $\text{R}^1$ ,  $\text{R}^2$ , and  $\text{R}^3$  are each hydrogen or an alkyl or aryl group.

Note 1: An example of polysilazane is:



poly[(phenylimino)(dimethylsilanediyl)]  
poly(*N*-phenyldimethylsilazane)

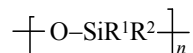
Note 2: Polysilazanes can comprise both silicon and nitrogen branching points, the former being formed from ammonia and the latter from, e.g., alkyltrichlorosilanes or tetrachlorosilane used as monomers:



where  $\text{R}^1$ ,  $\text{R}^2$ , and  $\text{R}^3$  are each hydrogen or an alkyl or aryl group.

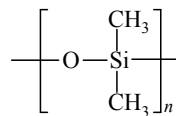
### 3.51 polysiloxane

Polymer composed of macromolecules containing alternating oxygen and silicon atoms in the backbone:



where R<sup>1</sup> and R<sup>2</sup> are each hydrogen or an alkyl or aryl group.

*Note 1:* An example of polysiloxane is:



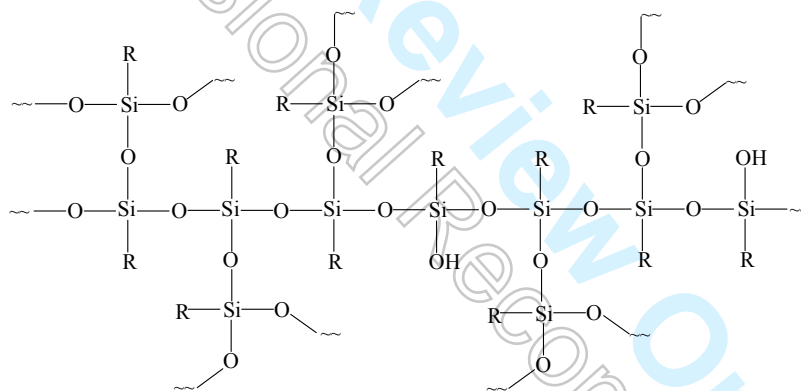
poly[oxy(dimethylsilanediy)]  
poly(dimethylsiloxane)

*Note 2:* Polysiloxanes are often referred to as *silicones* or *polyoxysilylenes*. Use of the last term is discouraged.

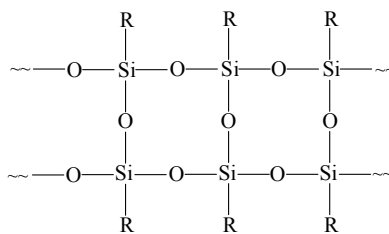
*Note 3:* *Polysilsesquioxanes* are a subclass of *polysiloxanes*.

### 3.52 polysilsesquioxane

Polymer composed of macromolecules containing silicon and oxygen atoms in the ratio 1:1.5 (ideal ratio for infinite macromolecule), which alternate in a *hyperbranched* or *ladder* structure such as:



hyperbranched silsesquioxane



ladder silsesquioxane



where R is alkyl, aryl or heteroaryl.

*Note 1:* The ideal value of the O : Si ratio of 1.5 : 1 is achieved only in the case of a *ladder polymer*. For hyperbranched polysilsesquioxanes, the value of the O : Si ratio is higher.

*Note 2:* Polysilsesquioxanes are a subclass of *polysiloxanes*.

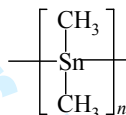
### 3.53 polystannane

Polymer composed of macromolecules containing exclusively tin atoms in the backbone:



where R<sup>1</sup> and R<sup>2</sup> are each hydrogen or an alkyl or aryl group.

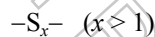
*Note:* An example of polystannane is:



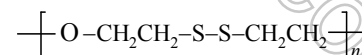
poly(dimethylstannanedyl)

### 3.54 polysulfide

Polymer composed of macromolecules containing sulfur-sulfur linkages in the backbone:



*Note 1:* An example of polysulfide is:

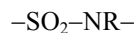


poly[oxyethylene(disulfanedyl)ethylene]

*Note 2:* A polymer with  $x = 1$  is a *polythioether* (see 3.62).

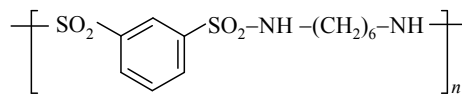
### 3.55 polysulfonamide

Polymer composed of macromolecules containing sulfonamide linkages in the backbone:



where R is hydrogen or an alkyl, aryl or heteroaryl group.

Note: An example of polysulfonamide is:



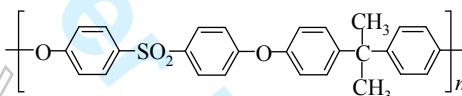
poly[sulfonyl(1,3-phenylene)sulfonylimino-hexane-1,6-diylimino]

### 3.56 polysulfone

Polymer composed of macromolecules containing sulfonyl linkages in the backbone:



Note 1: An example of polysulfone is:

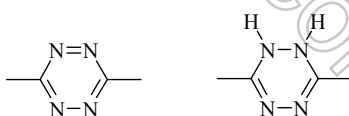


poly[oxy-1,4-phenylenesulfonyl-1,4-phenyleneoxy-1,4-phenylene(dimethylmethylene)-1,4-phenylene]

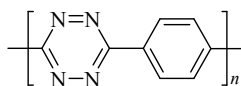
Note 2: Polysulfones that also comprise ether linkages in the backbone are more exactly classified as *polyethersulfones*. Similarly, other subclasses of polysulfones can be derived.

### 3.57 polytetrazine

Polymer composed of macromolecules containing 1,2,4,5-tetrazine or hydrogenated 1,2,4,5-tetrazine rings in the backbone:



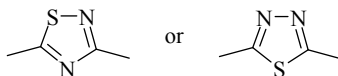
Note: An example of polytetrazine is:



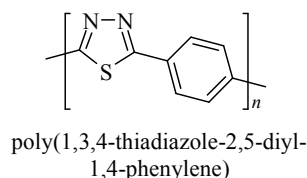
poly(1,2,4,5-tetrazine-3,6-diyl-1,4-phenylene)

### 3.58 polythiadiazole

Polymer composed of macromolecules containing 1,2,4-thiadiazole or 1,3,4-thiadiazole rings in the backbone:

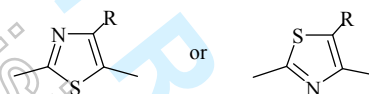


*Note:* An example of polythiadiazole is:



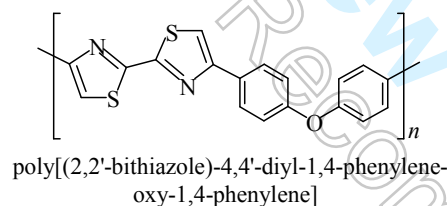
### 3.59 polythiazole

Polymer composed of macromolecules containing thiazole rings in the backbone:



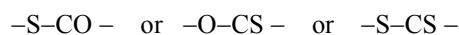
where R is hydrogen, alkyl, aryl, heteroaryl, substituted alkyl, substituted aryl or substituted heteroaryl.

*Note:* An example of polythiazole is:

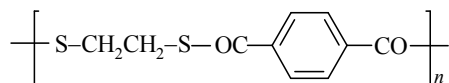


### 3.60 polythioester

Polymer composed of macromolecules containing thiocarboxylate (ester) linkages in the backbone:



*Note 1:* An example of polythioester is:



poly(sulfanedylethylenesulfanedylterephthaloyl)

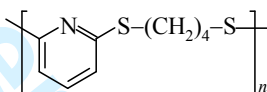
Note 2: Polymer containing only pendent thioester groups are excluded.

### 3.61 polythioether

Polymers composed of macromolecules containing thioether (sulfide) linkages in the backbone:



Note 1: An example of polythioether is:



poly(pyridine-2,6-diylsulfanedyl-butane-1,4-diylsulfanedyl)

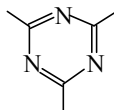
Note 2: A polymer containing only pendent thioether groups is excluded.

Note 3: A polymer with thioalkylene, thioarylene, thiomethylene or thiophenylene repeating units is classified more narrowly as a *polythioalkylene*, *polythioarylene*, *polythiomethylene*, or *polythiophenylene*.

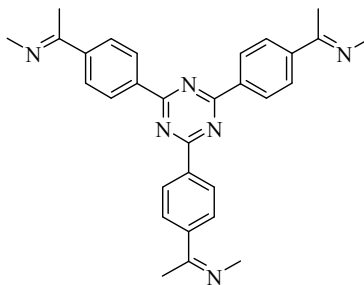
Note 4: A polymer with  $\text{S}_x$  ( $x > 1$ ) linkages is a *polysulfide* (see 3.55).

### 3.62 polytriazine

Polymer composed of macromolecules containing 1,3,5-triazine rings in the backbone:



Note 1: A polytriazine is usually a branched or network polymer:



Typical structure motifs of a polytriazine

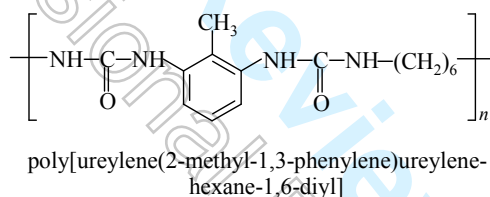
*Note 2:* A *polycyanurate* and an *amino polymer* prepared from melamine (1,3,5-triazine-2,4,6-triamine) are excluded; however, these polymers can be regarded as subclasses of polytriazines.

### 3.63 polyurea polyureylene

Polymer composed of macromolecules containing ureylene linkages in the backbone:



*Note 1:* An example of polyurea is:

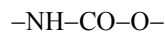


*Note 2:* An *amino polymer* prepared from urea and an aldehyde is excluded.

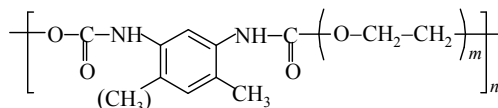
*Note 3:* A polymer containing only pendent ureylene groups is excluded.

### 3.64 polyurethane polycarbamate

Polymer composed of macromolecules containing carbamate (urethane) linkages in the backbone:



*Note 1:* An example of polyurethane is:

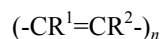


poly {oxycarbonylimino-(4(or 6)-methyl-1,3-phenylene)-  
iminocarbonyl[poly(oxyethylene)]}

*Note 2:* A polymer containing only pendent urethane groups is excluded.

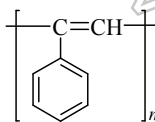
### 3.65 polyvinylene

Polymer composed of macromolecules containing exclusively vinylene, (ethene-1,2-diyl), or substituted vinylene units in the backbone:

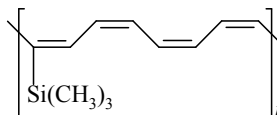


where  $\text{R}^1$  and  $\text{R}^2$  are each hydrogen or an alkyl, aryl or heteroaryl group.

*Note 1:* An example of polyvinylene is:



poly(1-phenylethene-1,2-diyl)  
poly(phenylacetylene)



poly[1-(trimethylsilyl)octa-1,3,5,7-tetraene-1,8-diyl]

*Note 2:* Polyvinylenes are a subclass of *polyacetylenes*. Unsubstituted poly(vinylene) is mostly referred to as *polyacetylene*.

*Note 3:* Polyvinylenes are *conjugated polymers*.

## 4. CLASS NAMES BASED ON MOLECULAR ARCHITECTURE

### 4.1 block polymer

Polymer composed of macromolecules consisting of a linear sequence of two or more blocks (see definitions 1.26, 1.62, 2.22 and 2.24 in ref. [9]).

*Note 1:* A block polymer can be represented graphically as follows:

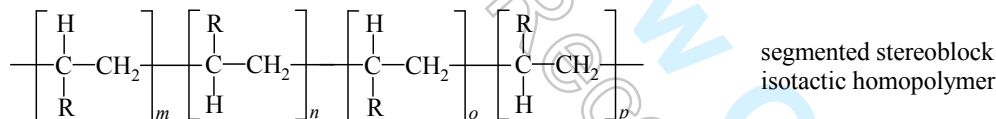
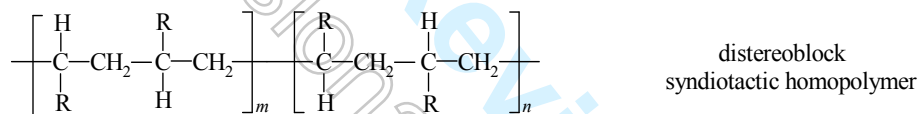


*Note 2:* A block polymer is a *block homopolymer* if all its blocks are derived from one species of monomer, or a *block copolymer* if its blocks are derived from two or more species of monomer.

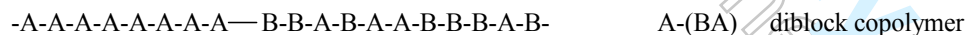
*Note 3:* In a *block homopolymer*, particular blocks differ in structural features such as regularity or tacticity:



or the blocks of the same tacticity can be linked through a diad of a configuration different from that of the diads inside blocks; this gives rise to so-called *stereoblock* or *segmented stereoblock homopolymers*:



*Note 4:* In a block copolymer, each block may consist of only one type of constitutional repeating unit, or it can comprise two or more different constitutional units.



*Note 5:* Block polymers are divided according to the number of blocks present in their macromolecules into *diblock*, *triblock*, *tetrablock*, ..., *multiblock polymers*. *Multiblock polymers* are often referred to as *segmented polymers*.

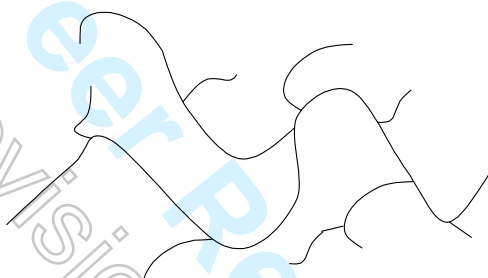
*Note 6:* The order of blocks along a block polymer molecule is usually specified as follows (in the representations, A, B, and C indicate monomeric units of different chemical or other structural features):

...-A-A-A-A-A—B-B-B-B-B-...	A-B diblock (co)polymer
...-A-A-A-A-A—B-B-B-...-B-B-B—C-C-C-C-C-...	A-B-C triblock (co)polymer
...-A-A-A-A-A—B-B-B-...-B-B-B—A-A-A-A-A-...	A-B-A triblock (co)polymer
$(A_i)-(B_n)-(A_j)-(B_n)-(A_k)-(B_n)-\dots$ i.e. $[(A_k)-(B_m)]_n$	A-B multiblock (co)polymers [A-B segmented (co)polymer]

## 4.2 branched polymer

Polymer composed of macromolecules with branched main chains.

*Note 1:* A molecule of a branched polymer can be represented graphically as follows:



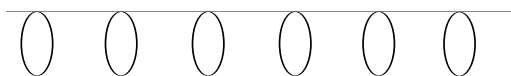
*Note 2:* Branched polymers are polymers composed of macromolecules having a linear main chain from which one or more oligomeric or polymeric offshoots (side chains, branches) emanate (see definitions 1.33 and 2.34 in ref. [9]).

*Note 3:* *Comb polymers, dendritic polymers, graft polymers, hyperbranched polymers and star polymers* are subclasses of branched polymers.

## 4.3 cardo polymer

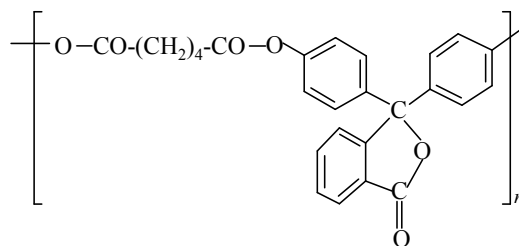
Polymer composed of macromolecules consisting of a single-strand main chain and many ring units, each having one atom in common with the main chain:

*Note 1:* A cardo polymer can be represented graphically as follows:



*Note 2:* An example of cardo polymer is:





poly(oxyadipoyloxy-1,4-phenylene-phthalide-3,3-diyl-1,4-phenylene)

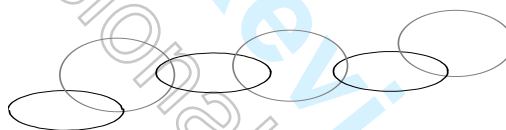
*Note 3:* A cardo polymer can be also defined as a polymer composed of macromolecules containing loop-like cyclic side groups, one ring atom of which is part of the backbone.

*Note 4:* The adjective “cardo” is derived from the Latin expression for heart because the cyclic unit, together with adjacent parts of the main chain, resembles the shape of a heart with arteries.

#### 4.4 catenane polymer

Polymer composed of macromolecules consisting of physically catenated macrorings that have no atom in common and cannot be separated unless chemical bonds are broken.

*Note 1:* A catenane polymer can be graphically represented as follows:



*Note 2:* A catenane-polymer main chain resembles a jewelry or technical chain of physically interlocked rings.

*Note 3:* A catenane polymer can be a linear, branched, or network polymer.

#### 4.5 comb polymer

Polymer composed of macromolecules consisting of a linear main chain from which a large number of linear oligomeric side-chains emanate, so resembling a comb-like shape in the planar projection.

*Note 1:* A comb polymer can be represented graphically as follows:



regular comb macromolecule



irregular comb macromolecules

*Note 2:* Comb polymers are polymers composed of macromolecules comprising a main chain with multiple trifunctional branch points from each of which a linear side chain emanates (see definitions 1.52 and 2.33 in ref. [9]).

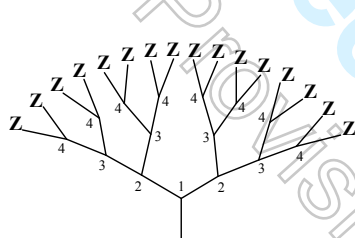
*Note 3:* A comb polymer can be also regarded as a graft polymer; however, the density of side chains is typically much lower in graft polymers.

*Note 4:* A comb macromolecule in which branching points are along chain separated by a few atoms only, typically by one atom, acquires the shape of a brush due to steric reasons and, therefore, it is usually referred to as the *brush macromolecule*. A polymer composed of such macromolecules is usually called the *brush polymer*.

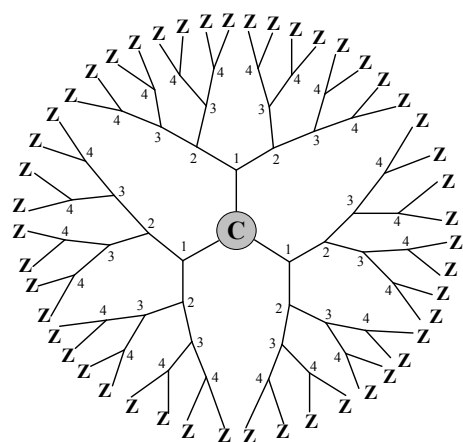
*Note 5:* Comb polymers are a subclass of *branched polymers*.

#### 4.6 dendritic polymer

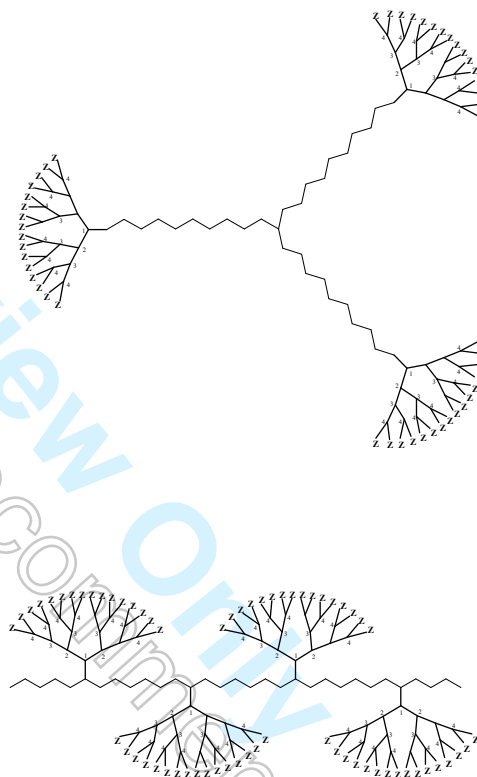
Polymer composed of molecules containing one or more subchains with regular, cascade-like branching architecture, which are referred to as dendrons.



dendron of fourth generation composed of constitutional repeating units of connectivity 3 and terminal units Z



dendrimer of fourth generation composed of three dendrons given above emanating from a core unit C



Examples of more complicated dendritic polymer molecules; the molecule of the structure type shown at bottom is usually referred to as the dendrigraft molecule

*Note 1:* A single, regularly branched chain exclusively consisting of repeating constitutional units of connectivity three or higher and a number of terminal units Z is called a *dendron*.

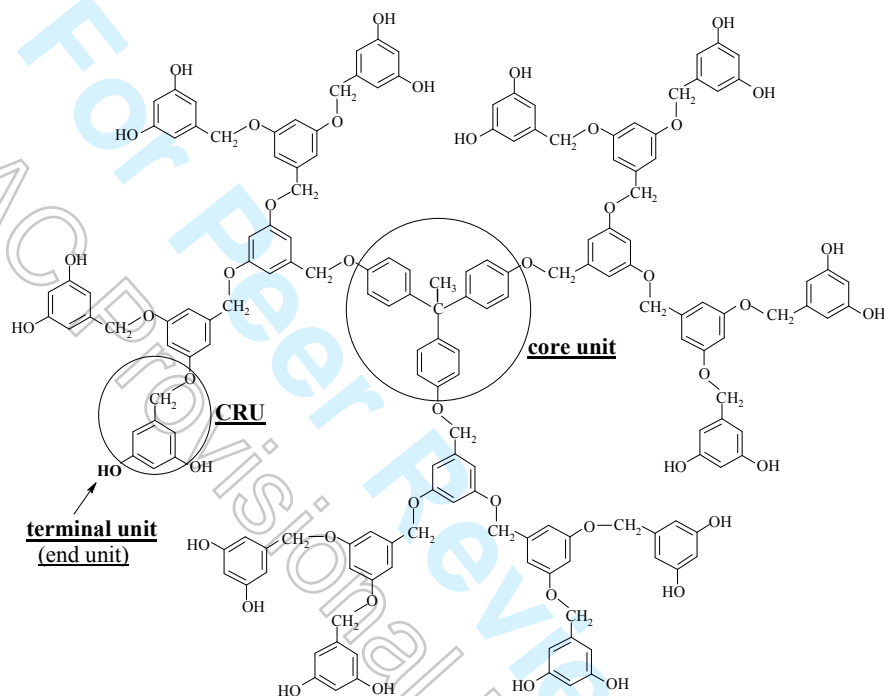
*Note 2:* The term *dendron* is also used for naming the simplest possible *dendrimer* having a core unit with connectivity one.

*Note 3:* Connectivity of a constitutional unit is equal to the number of connections through which the repeating unit is built in a molecule.

*Note 4:* A molecule of a dendritic polymer consisting of one or more dendrons emanating from a single non-repeating unit, referred to as a core unit, is called a *dendrimer*.

*Note 5:* Repeating units linked directly to the core unit are referred to as the repeating units of the first generation; the repeating units forming next layer are of the second generation, etc. (see numbers in the scheme of a *dendrimer* of fourth generation shown above).

*Note 6:* An example of the chemical structure of a *dendrimer* is:



$\alpha$ -(ethane-1,1,1-triyltri-1,4-phenylene)- $\omega$ -hydroxy-*dendro*-oxymethylenebenzene-1,3,5-triyl  
 core unit                      terminal units (end units)                      constitutional repeating units (CRU)

*Note 7:* Dendritic polymers are a subclass of *branched polymers*.

#### 4.7 double-strand polymer

Polymers composed of virtually linear macromolecules consisting of two single-strand subchains multiply connected by a short transverse linkage, or a single atom in common, or both.



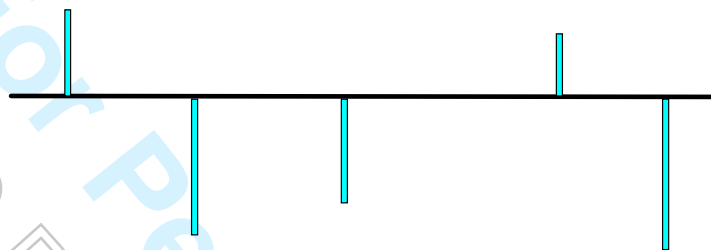
*Note 1:* Polymers composed of macromolecules comprising constitutional units connected in such a way that adjacent constitutional units are joined to each other through three or four atoms, two on one side and

either one or two on the other side of each constitutional unit (see definitions 1.40, 1.41 and 2.30 in ref. [9]).

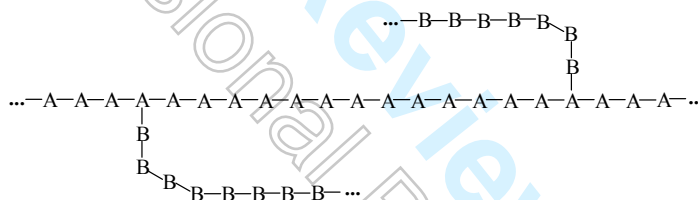
*Note 2:* *Ladder polymers* (see 4.11) and *spiro polymers* (see 4.17) are subclasses of double-strand polymers.

#### 4.8 graft polymer

Polymer composed of branched or comb-like macromolecules, in which chemical constitution of the side chains differs from that of the main chain.



*Note 1:* Graft polymers are polymers composed of macromolecules with one or more species of block connected to the main chain as side-chains, these side chains having constitutional or configurational features that differ from those in the main chain (see definitions 1.28, 2.23 and 2.25 in ref. [9]), for example:

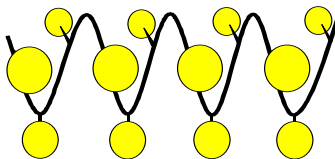


where A and B are constitutional units that differ in the chemical structure, configurational arrangement, or both.

*Note 2:* Graft polymers are a subclass of *branched polymers*.

#### 4.9 helical polymer

Polymer composed of macromolecules that adopt partly or completely a helical conformation.

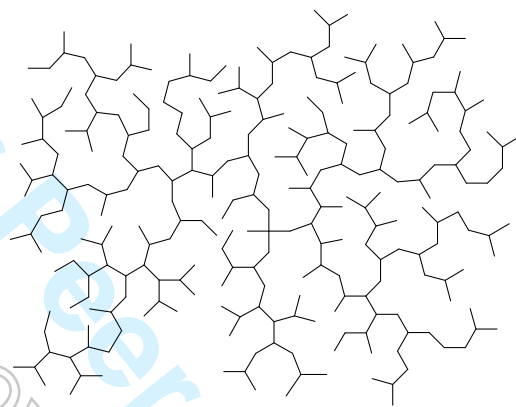


*Note 1:* Biopolymers such as nucleic acids, amylose, and some proteins are typical helical polymers.

*Note 2:* A helical structure is generated by regularly repeating rotations around the backbone bonds of a linear macromolecule (see definition 2.6 in ref. [10], chapter 4).

#### 4.10 hyperbranched polymer

Polymer composed of highly branched macromolecules in which any linear subchain may lead in either direction to at least two other subchains.



*Note 1:* A hyperbranched polymer molecule can also have a core unit (4.6).

*Note 2:* Macrocycles can also occur in a real hyperbranched macromolecule.

*Note 3:* Hyperbranched polymers are a subclass of *branched polymers*.

#### 4.11 ladder polymer

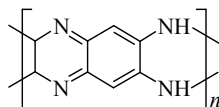
Polymer composed of double-strand macromolecules in which two parallel single-strand chains are multiply connected with a short transverse linkage, so resembling a ladder by the shape in the planar projection.



*Note 1:* Ladder polymers are polymers composed of double-strand macromolecules consisting of an uninterrupted linear sequence of rings, with adjacent rings having two or more atoms in common (see definitions 1.44, 1.45 and 2.30 in ref [9]).

*Note 2:* Ladder polymers are a subclass of *double-strand polymers* as well as a subclass of *linear polymers*.

*Note 3:* An example of ladder polymer is:



poly[(quinoxaline-2,3:6,7-tetracyl)-6,7-diimino]

*Note 4:* An imperfect ladder polymer, in molecules of which single-strand linkages occur between ladder sequences, is commonly referred to as a *semiladder polymer*.

#### 4.12 linear polymer

Polymer composed of macromolecules, the cross-section of which is negligible compared to the contour length.

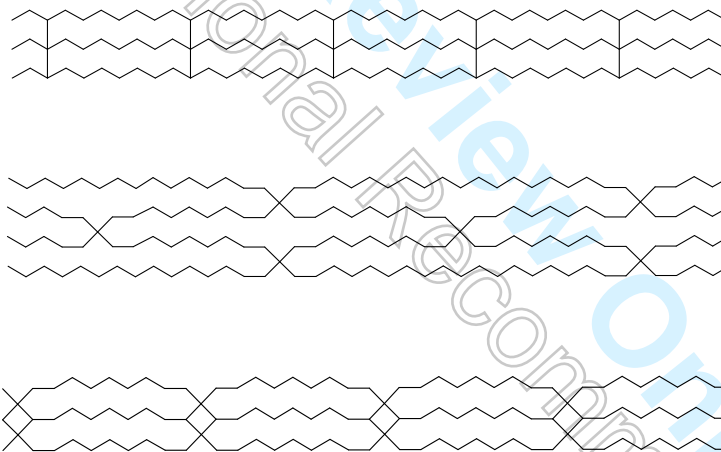


*Note 1:* Linear polymers are polymers composed of macromolecules, the structure of which essentially comprises the multiple repetition in linear sequence of units derived, actually or conceptually, from molecules of low relative molecular mass (see definitions 1.6, 1.32, 2.27 and 2.28 in ref. [9]).

*Note 2:* *Single-strand polymers*, *double-strand polymers*, and *multi-strand polymers* are subclasses of linear polymers.

#### 4.13 multi-strand polymer

Polymer composed of linear macromolecules consisting of three or more parallel single strand chains multiply connected by short transverse linkages, or single atoms in common, or both.

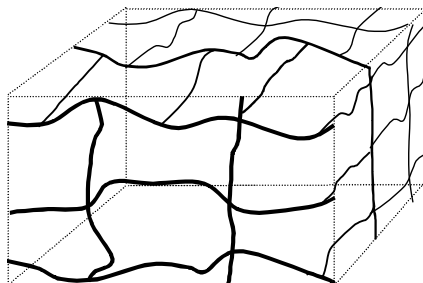


*Note 1:* Multi-strand polymers are polymers composed of macromolecules comprising constitutional units connected in such a way that adjacent constitutional units are joined to each other through more than four atoms, more than two on at least one side of each constitutional unit (see definitions 1.46 and 1.47 in ref. [9]).

*Note 2:* Multistrand polymers are a subclass of *linear polymers*.

#### 4.14 network polymer polymer network

Polymer composed of macromolecule(s) consisting of a large number of conjoined macrocycles, each having at least three subchains in common with neighboring macrocycles.



*Note 1:* Network is defined (see definitions 1.58 and 2.41 in ref. [9]) as a highly ramified macromolecule in which essentially each constitutional unit is connected to each other constitutional unit and to the macroscopic phase boundary by many permanent paths through the macromolecule, the number of such paths increasing with the average number of intervening bonds.

*Note 2:* Some pendent linear and branched chains with free ends commonly occur in network polymers.

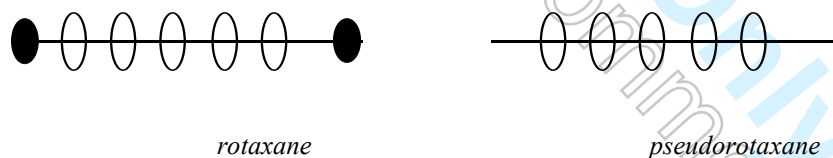
*Note 3:* A network polymer prepared by a crosslinking of an original linear or branched polymer is commonly named on the process-based principle as a *crosslinked polymer*.

*Note 4:* A polymer network of colloidal dimensions is referred to as a *micronetwork* (see definition 1.60 in ref. [9]).

*Note 5:* A swollen network polymer is a *gel*; a swollen micronetwork is a *microgel*.

#### 4.15 rotaxane polymer

Polymer composed of complex macromolecules consisting of cyclic molecules threaded by a linear macromolecule that is eventually capped with bulky end units preventing de-threading of cyclic molecules.



*Note:* A rotaxane polymer composed of molecules without bulky end-groups on the central macromolecule is usually referred to as a *pseudorotaxane polymer*.

#### 4.16 single-strand polymer

Polymer composed of macromolecules consisting of a single linear chain:

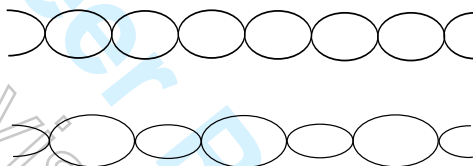


*Note 1:* Single-strand polymers are polymers composed of macromolecules comprising constitutional units connected in such a way that adjacent constitutional units are joined to each other through two atoms, one on each constitutional unit (see definitions 1.38, 1.39 and 2.29 in ref. [9]).

*Note 2:* Single-strand polymers are a subclass of *linear polymers*.

#### 4.17 spiro polymer

Polymer composed of double-strand macromolecules consisting of two single-strand subchains multiply connected by a single atom in common.

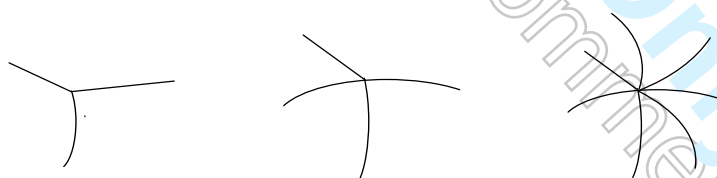


*Note 1:* Polymers composed of double-strand macromolecules consisting of an uninterrupted linear sequence of rings, with adjacent rings having only one atom in common (see definitions 1.42 and 1.43 in ref. [9]).

*Note 2:* Spiro polymers are a subclass of *linear polymers* and a subclass of *double-strand polymers*.

#### 4.18 star polymer

Polymer composed of branched macromolecules containing only one common branch unit, so resembling a star by shape.



three-star macromolecule    four-star macromolecule    seven-star macromolecule

*Note 1:* Star polymers are polymers composed of macromolecules containing a single branch point (either a single atom or a group of atoms) from which three or more linear chains (arms) emanate (see definitions 1.51 and 2.32 in ref. [9]).

*Note 2:* A star macromolecule with  $n$  linear chains (arms) attached to the branch point is termed an  $n$ -star macromolecule (see definition 1.51 in ref. [9]).



## 5. REFERENCES

1. G. P. Moss, P. A. S. Smith, D. Tavernier. *Pure Appl. Chem.* **67**, 1307 (1995).
2. N. A. Plate, I. M. Papisov. *Pure Appl. Chem.* **61**, 243-254 (1989); reprinted as Chapter 8 in Ref. 10.
3. *Polymer Handbook*, 4th ed. (Brandrup, J.; Immergut, E. H.; Grulke, E. A., eds.). John Wiley & Sons, New York, 1999.
4. *Handbook of Chemistry and Physics*, 88th ed. (Lide, D. R., ed.). CRC Press, Florida, 2007.
5. *Encyclopedia of Polymer Science and Engineering*, 3rd ed. (Mark, H. F.; Bikales, N. M.; Overberger, C. G.; Menges, G., eds.). John Wiley & Sons, New York, 2004.
6. *Comprehensive Polymer Science* (Allen, G.; Bevington, J. C.; Booth, C., eds.). Pergamon Press, Oxford, 1989.
7. *Polymeric Materials Encyclopedia* (Salamone, J. C., ed.). CRC Press, Boca Raton, Florida, 1996.
8. *CA Index Guide 2004*. Chemical Abstracts Service, Columbus, Ohio, 2004; Appendix I: "Hierarchies of General Subject Headings", Appendix III: "Selection of General Subject Headings".
9. A. D. Jenkins, P. Kratochvíl, R. F. T. Stepto and U. W. Suter. *Pure Appl. Chem.* **68**, 2287 (1996).
10. *Compendium of Macromolecular Nomenclature* (Metanomski, W. V., ed.). Blackwell Scientific Publications, Oxford, 1991.
11. J. Kahovec, P. Kratochvíl, A. D. Jenkins, I. Mita, I. M. Papisov, L. H. Sperling and R. F. T. Stepto. *Pure Appl. Chem.*, **69**, 2511 (1997).
12. E. Maréchal, E. S. Wilks. *Pure Appl. Chem.* **73**, 1511 (2001).
13. L. G. Donaruma, B. P. Block, K. L. Loening, N. Plate, T. Tsuruta, K. Ch. Buschbeck, W. H. Powell, J. Reedijk. *Pure Appl. Chem.* **57**, 149 (1985); Reprinted as Chapter 6 in Ref. 10.
14. J. Kahovec, R. B. Fox, K. Hatada. *Pure Appl. Chem.* **74**, 1921 (2002).
15. *A Guide to IUPAC Nomenclature of Organic Compounds*, (Panico, R.; Powell, W. H.; Richer, J.-C., eds.). Blackwell Scientific Publications, Oxford, 1993.
16. W. Ring, I. Mita, A. D. Jenkins, N. M. Bikales. *Pure Appl. Chem.* **57**, 1427 (1985); Reprinted as Chapter 7 in Ref. 10.
17. K. Horie, M. Barón, R. B. Fox, J. He, M. Hess, J. Kahovec, T. Kitayama, P. Kubisa, E. Maréchal, W. Mormann, R. F. T. Stepto, D. Tabak, J. Vohlidal, E. S. Wilks, W. J. Work. *Pure Appl. Chem.* **76**, 889 (2004).
18. M. Hess, R. G. Jones, J. Kahovec, T. Kitayama, P. Kratochvíl, P. Kubisa, W. Mormann, R. F. T. Stepto, D. Tabak, J. Vohlidal, E. S. Wilks. *Pure Appl. Chem.* **78**, 2067 (2006).

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