



IUPAC

INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

IUPAC- Polymer Division IV Subcommittee on Polymer Terminology

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CHAIR : Patrick Theato

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INTRODUCTION

In 1952, the Sub-commission on Nomenclature to the **IUPAC Commission on Macromolecules** published its first recommendations. In 1968 IUPAC formally established the Commission on Macromolecular Nomenclature (Commission IV.1), which became the leading nomenclature body in the field of polymers. In 2002 the Commission became the Subcommittee on Macromolecular Terminology, and in 2005 was renamed the **Subcommittee on Polymer Terminology**.

As well as being tasked with establishing **terminological rules and definitions**, the Subcommittee also advises the **Chemical Nomenclature and Structure Representation Division (VIII)** on the development of polymer nomenclature.

As the former Commission, rules were developed for naming regular single-strand macromolecules, copolymer molecules, irregular macromolecules, ladder and spiro macromolecules, and nonlinear and network polymers. Rules for representing the structures of macromolecules were also developed. Latterly, while still addressing issues of **polymer nomenclature**, the Subcommittee has worked to **standardize the terminology** used in polymer science. Amongst other topics, it has developed a glossary of basic terms, and made recommendations concerning the terminology of assemblies of polymer molecules and non-linear macromolecules, polymer solutions, polymer crystals, types of polymerization, kinetics and thermodynamics of polymerization, degradation and aging of polymers, and the mechanical behavior of polymers.

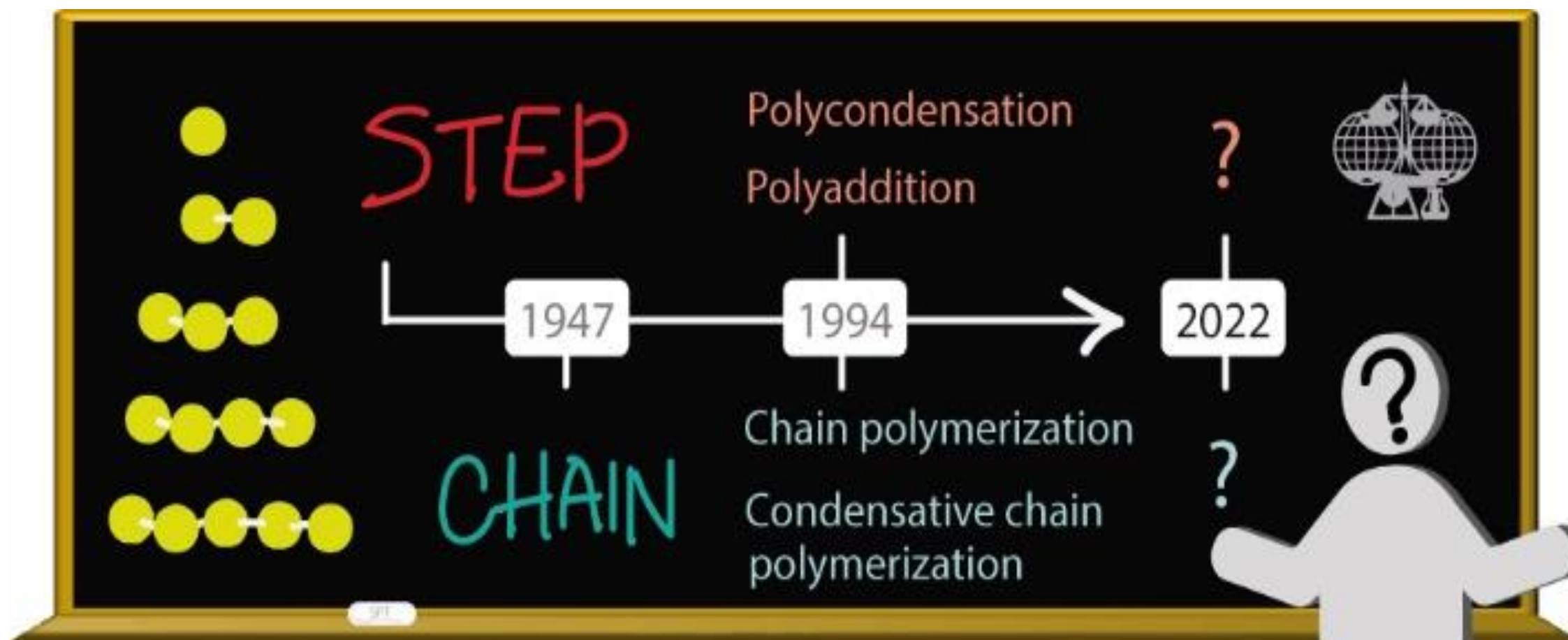
Since its inception, the Subcommittee has attracted the participation of exceptional scientists from **academia, publishing houses, and the polymer industry**.

ONGOING PROJECTS

Project number	Acronym	TGL	Project title
2023-007-1-400	MASSIVE	Keddie	Clarifications of Definitions for Polymer Molar Mass Averages
2022-006-2-400	R-BGN	Hiorns	Revision of the Brief Guide to Polymer Nomenclature
2020-024-3-400	SUPRA	Gosecka	Nomenclature and terminology for supramolecular polymers
2019-043-2-400	GOLDEN	dos Santos	Gold Book Updates for Polymers
2019-041-3-400	SEQ	Theato	Nomenclature of Sequence-Controlled Polymers
2019-036-1-800	STARS2	Chen	Structure-based nomenclature for irregular linear, star, comb and brush polymers with different types of constitutional repeating units (CRU)
2019-027-1-400	OVER	Matson	Basic classification and definitions of polymerization reactions
2019-010-2-400	AGGREGATES	Nakano	Terminology of Polymer Aggregates
2018-033-1-400	ADDIPLAST	(Malinconico) Giuntini	Additives intended to promote the degradation of polyolefin-based thermoplastic materials
2016-050-3-400	μSTRUCTURE	Stingelin	Definition of Terms Pertaining to Polymers in the Solid State: Molecular Arrangement from the Nano- to the Micrometer Scale
2017-039-2-800	GRAPHIC	Theato	Graphical Representation of Polymer Structures
2015-050-1-400	ULTIMATE	Adhikari	Definition of Terms Relating to the Ultimate Mechanical Properties of Polymers
2015-049-1-400	CHAR	Topham	Brief Guide to the Characterisation of Polymers
2015-032-2-400	WIKI	Hess	Synchronizing Wikipedia: Polymer Definitions and Terminology
2015-014-1-400	SEMS	Walter	Guide (and Brief Guide) to Polymer Semiconductors
2014-014-1-400	MODSIM	Meille	Terminology for Modeling and Simulation of Polymers
2013-049-1-400	SEPARATION	Hess	Terminology on the separation of macromolecules
2011-035-1-800	TINCOPS	Jones	Terminology and nomenclature of inorganic and coordination polymers – an extended revision of Nomenclature for regular single-strand and quasi-single-strand inorganic and coordination polymers (1984)

Reconsidering Terms for Mechanisms of Polymer Growth: The "Step-Growth" and "Chain-Growth" Dilemma

Chin Han Chan, Jiun-Tai Chen, Wesley S. Farrell, Christopher M. Fellows, Daniel J. Keddie, Christine K. Luscombe, John B. Matson, Jan Merna, Graeme Moad, Gregory T. Russell, Patrick Theato, Paul D. Topham, Lydia Sosa-Vargas



We do not recommend new terms here. Instead, members of SPT detail our concerns with these terms and seek suggestions from the community on how to provide **clear, simple, and consistent** terms to describe the **two major mechanisms** of polymer growth.

Reference: *Polym. Chem.* **2022**, *13*, 2262–2270. doi: 10.1039/d2py00086e

A Brief Guide to Polymer Terminology (IUPAC Technical Report)

R. C. Hiorns¹, P. Hodge², J. Vohlidal³, C. K. Ober⁴, R. Boucher⁵, B. K. Brettmann⁶, T. Chang⁷, J. Z. Chen⁸, C. M. Fellows⁹, A. Fradet¹⁰, F. Giuntini¹¹, M. Gosecka¹², C. F. O. Graeff¹³, D. N. Haase¹⁴, J. He¹⁵, K. H. Hellwich¹⁶, M. Hess¹⁷, R. Hiorns¹⁸, P. Hodge¹⁹, W. Hu²⁰, J. I. Jin²¹, D. J. Keddie²², C. K. Luscombe²³, P. Mallon²⁴, S. Valdo Meille²⁵, J. Merna²⁶, G. Moad²⁷, T. Nakano²⁸, C. K. Ober²⁹, M. Peeters³⁰, O. E. Philippova³¹, G. Raos³², G. T. Russell³³, L. S. Vargas³⁴, N. Stingelin³⁵, A. Sturcova³⁶, P. D. Topham³⁷, J. P. Vairon³⁸, M. Walter³⁹, E. Wilks⁴⁰, A. Yerin⁴¹, M. Yoon⁴², Y. Miyasaka⁴³

1) Introduction This structure is intentionally different from the doublet macromolecule which is tree-like and carries one or more doublets. A related class is that of cross-linked polymers which are not grafted along its backbone.

2) Macromolecules and Polymers The terms macromolecule and polymer do not mean the same thing. A polymer is a substance composed of macromolecules of high molar mass (M). An individual macromolecule is of intermediate molar mass such that a change in the number of units will noticeably alter its properties.

3) Configuration and Stereoisomerism Isomers have the same atomic composition but different three-dimensional structures. An isomerism is a relationship between two structures that can be interconverted by a rotation about a single bond.

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RECENT PUBLICATIONS

IUPAC Recommendation

Christopher M. Fellows, Richard G. Jones¹, Daniel J. Keddie, Christine K. Luscombe, John B. Matson, Krzysztof Matyjaszewski, Jan Merna, Graeme Moad², Tamaki Nakano, Stanislaw Penczek, Gregory T. Russell and Paul D. Topham

Terminology for chain polymerization (IUPAC Recommendations 2021)

<https://doi.org/10.1039/d1py00001a>
Received December 19, 2020; accepted June 9, 2022

Abstract: Chain polymerizations are defined as chain reactions where the propagation steps occur by reaction between monomer(s) and active site(s) on the polymer chains with regeneration of the active site(s) at each step. Many forms of chain polymerization can be distinguished according to the mechanism of the propagation step (e.g., cyclopolymerization – when rings are formed, condensative chain polymerization – when propagation is a condensation reaction, group-transfer polymerization, polyaddition, ring-opening polymerization – when rings are opened), whether they involve a termination step or not (e.g., living polymerization – when termination is absent, reversible-deactivation polymerization), whether a transfer step is involved (e.g., degenerative-transfer polymerization), and the type of chain carrier or active site (e.g., radical, ion, electrophile, nucleophile, coordination complex). The objective of this document is to provide a

Keywords: active species; biologically active conjugate; carrier; conjugation; drug delivery; pharmaceutically active conjugates; protein-based conjugate; substrate; support.

CONTENTS

- CON-1 Preamble 560
- CON-2 Structures and Limitations 560
- CON-2.1 Structural base conjugation 560
- CON-2.2 Conjugations in a conjugate 561

IUPAC Recommendations

Michel Vert¹, Jiāzhong Chen, Andrey Yerin, Karl-Heinz Hellwich, Roger C. Hiorns, Richard Jones², Graeme Moad and Gerard P. Moss

Terminology and the naming of conjugates based on polymers or other substrates (IUPAC Recommendations 2021)

<https://doi.org/10.1039/d1py00002a>
Received May 13, 2020; accepted January 9, 2022

Abstract: A number of human activities require that certain complex molecules, referred to as active species (drugs, pigments, proteins, genes, radioactive labels, etc.), be combined with substrates, often a macromolecule, to form temporary or permanent conjugates. The existing IUPAC organic, polymer, and inorganic nomenclature principles can be applied to name such conjugates but it is not always appropriate. These nomenclatures have two major shortcomings: (1) the resulting names are often excessively long and (2) identification of the components (substrate, active species, and link) can be difficult. The new IUPAC naming system elaborates rules for unambiguous and facile naming of any conjugate. This naming system is not intended to replace the existing nomenclature but to provide a suitable alternative when dictated by necessity. Although the rules are intended to be primarily applicable to the naming of polymer conjugates, they are also applicable to naming conjugates with other substrates, which include micelles, particles, minerals, surfaces, pores, etc. The naming system should be used when recognition of the substrate and active substance is essential and will also be useful when constraints of name length make the otherwise preferred IUPAC nomenclatures untenable. The proposed rules for the new naming system are complemented by a glossary of relevant terms.

Keywords: Active species; biologically active conjugate; carrier; conjugation; drug delivery; pharmaceutically active conjugates; protein-based conjugate; substrate; support.

CONTENTS

- CON-1 Preamble 560
- CON-2 Structures and Limitations 560
- CON-2.1 Structural base conjugation 560
- CON-2.2 Conjugations in a conjugate 561

IUPAC Recommendations

Jiāzhong Chen¹, Edward S. Wilks², Alain Fradet, Karl-Heinz Hellwich, Roger C. Hiorns, Tamaki Nakano, Claudio G. dos Santos and Patrick Theato

Structure-based nomenclature for irregular linear, star, comb, and brush polymers (IUPAC Recommendations 2020)

<https://doi.org/10.1039/d0py00001a>
Received January 10, 2020; accepted January 25, 2021

Abstract: The existing recommendations for the structure-based nomenclature of regular single-strand organic polymers are extrapolated to complex polymers. The key proposal is that polymeric entities may be named substituents. The types of polymers covered include linear and branched polymers containing more than one block of a single type of constitutional repeating unit (CRU) and branched polymers containing more than one block of a single type or more polymer side chains emanate.

Keywords: Brush-shaped polymers; comb-shaped polymers; IUPAC; Division of Chemical Nomenclature and Structure Representation; IUPAC Polymer Division; linear polymers; Nomenclature Recommendations; star-shaped polymers; structure-based polymer names.

SCB-1 Introduction

Between 1984 and 2012, the IUPAC published several documents containing recommendations for the nomenclature of a wide variety of polymer types such as regular linear single-strand [1, 2], irregular single-strand [2, 3], organic regular double-strand [2, 4], and cyclic organic macromolecules [5], non-linear macromolecules and macromolecular assemblies [2, 6], and quasi-single-strand inorganic and coordination polymers [7]. More recently a document on source-based nomenclature for single-strand homopolymers and copolymers was published in 2016 [8], and a document on nomenclature for dendrimers and hyperbranched polymers was published in early 2019 [9]. However, structure-based nomenclature for certain types of

CONTENTS

- AL-1 Introduction 1865
- AL-2 Terminology 1866
- AL-2.1 absence, A_{1n} , A_n , B 1866
- AL-2.2 adhesion 1866
- AL-2.3 adhesion promoter 1866
- AL-2.5 aerial edge 1867
- AL-2.6 annealing (in polymer science) 1867
- AL-2.6.1 solvent vapor annealing 1867
- AL-2.6.2 thermal annealing (in lithography) 1867
- AL-2.7 anti-reflective coating (ARC) 1867
- AL-2.8 aqueous-phase development 1867
- AL-2.9 aspect ratio (in lithography) 1867
- AL-2.10 atomic force microscopy (AFM) 1867

IUPAC Recommendations

Richard G. Jones¹, Christopher K. Ober, Teruaki Hayakawa, Christine K. Luscombe and Natalie Stingelin

Terminology of polymers in advanced lithography (IUPAC Recommendations 2020)

<https://doi.org/10.1039/d0py00002a>
Received December 18, 2019; accepted July 15, 2020

Abstract: As increasingly smaller molecular materials and material structures are devised or developed for technological applications, the demands on the processes of lithography now routinely include feature sizes that are of the order of 10 nm. In reaching such a fine level of resolution, the methods of lithography have increased markedly in sophistication and brought into play terminology that is unfamiliar, on the one hand, to scientists tasked with the development of new lithographic materials or, on the other, to the engineers who design and operate the complex equipment that is required in modern day processing. Publications produced by scientists need to be understood by engineers and vice versa, and these commonly arise from collaborative research that draws heavily on the terminology of one or more of the traditional disciplines. It is developments in polymer science and material science that lead progress in areas that cross traditional boundaries, such as micro lithography. This document provides the exact definitions of a selection of unfamiliar terms that researchers and practitioners from different disciplines might encounter.

Keywords: microlithography; nanotechnology; polymers; recommendations; terminology.

CONTENTS

- AL-1 Introduction 1865
- AL-2 Terminology 1866
- AL-2.1 absence, A_{1n} , A_n , B 1866
- AL-2.2 adhesion 1866
- AL-2.3 adhesion promoter 1866
- AL-2.5 aerial edge 1867
- AL-2.6 annealing (in polymer science) 1867
- AL-2.6.1 solvent vapor annealing 1867
- AL-2.6.2 thermal annealing (in lithography) 1867
- AL-2.7 anti-reflective coating (ARC) 1867
- AL-2.8 aqueous-phase development 1867
- AL-2.9 aspect ratio (in lithography) 1867
- AL-2.10 atomic force microscopy (AFM) 1867

PERSPECTIVES - List of envisioned projects

- Degradation of Polymers (Gardette)
- Revision of Purple Book (Theato)
- Polymers of Relevance to Human Health (Stingelin)
- Polymers for 3D printing (Walter)
- Terminology for constitutionally-dynamic polymers (Vohlidal)
- Terminology of renewable and recycled polymers (Vairon)
- Electronic Formulae of Polymers (Yerin)
- Drawing of chemical structures of polymeric networks (Theato)
- Sustainable Polymers (Topham)
- Terminology of copolymerization (Moad)
- Polyaddition/polycondensation ...

Compendium of Polymer Terminology and Nomenclature IUPAC Recommendations 2008

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