

# **IUPAC Polymer Division (IV): History of IUPAC Polymer Terminology and Nomenclature**

From the 1920s, as polymer science developed and came of age, so too a common language came into being through the efforts of individuals who recognized the need for such a language. They formed committees to consider issues that included not only systematic nomenclature, but terminology and definitions, symbols, and other matters that might affect communication. All of this effort forms a part of the prehistory of the work of Division IV on polymer terminology and nomenclature.

## **SUB-COMMISSION ON NOMENCLATURE**

The first publication of the IUPAC in the area of macromolecular nomenclature was in 1952 by the Sub-commission on Nomenclature of the then IUPAC Commission on Macromolecules, which drew on the talents of such remarkable individuals as J. J. Hermans, M. L. Huggins, O. Kratky, and H. F. Mark. That report [1] was a landmark in that, for the first time, it systematized the naming of macromolecules and certain symbols and terms commonly used in polymer science. It introduced the use of parentheses in source-based polymer names when the monomer from which the polymer is derived consists of more than one word, a practice that is now widely followed, and it recommended an entirely new way of naming polymers based on their structure that included the suffix “amer”, a recommendation that has been almost totally ignored. After ten years, the Sub-commission issued its second report [2], which dealt with the then-burgeoning field of stereoregular polymers. A revision [3] of definitions in the original report appeared four years later. In 1968, a summary report [4] of the activities of the Sub-commission was published.

## **COMMISSION ON MACROMOLECULAR NOMENCLATURE (COMMISSION IV.1)**

In 1968, the Commission on Macromolecular Nomenclature of the Macromolecular Division (Division IV)\* was established under the Chairmanship of Kurt L. Loening with first Lionel C. Cross and later Robert B. Fox as Secretary. A series of major documents was produced that shaped modern polymer language. Most noteworthy was one that defined basic terms [5,6] and another on structure-based nomenclature for regular single-strand polymers [7,8]. The latter, originally developed by the Nomenclature Committee of the Polymer Division of the American Chemical Society and refined by the Commission, revolutionized polymer nomenclature by providing a systematic, consistent scheme particularly well-adapted to indexing; it became the standard for *Chemical Abstracts* and

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\* The name of Division IV was changed in 2004 to ‘Polymer Division.’

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major polymer journals throughout the world. A list of standard abbreviations was published [9-11] and later revised [12].

As the 1970s came to a close, Aubrey Jenkins assumed the Chairmanship, with Robert B. Fox continuing as Secretary through 1979, to be succeeded by Norbert Bikales, who served as Secretary until 1987. There followed in the 1980s a complete revision of the stereochemical definitions [13,14], terminology for molar masses in polymer science [15], an extension of structure-based nomenclature to inorganic and coordination polymers [16,17], the systemization of source-based nomenclature for copolymers [18] and key documents dealing with physicochemical terminology in the polymer field, covering definitions for individual macromolecules, their assemblies, and dilute solutions [19], crystalline polymers [20], a new method of classifying polymers [21] and a basic classification and definitions of polymerization reactions [22]. These documents were completed under the Chairmanship of Pavel Kratochvíl, who assumed this post in 1985; William J. Work was elected Secretary in 1987. In 1991, the first edition of the Purple Book (the Compendium of Macromolecular Nomenclature) [23] was published. The Compendium was the first major compilation of the Commission and consisted of an introduction to macromolecular nomenclature and nine chapters corresponding to the then valid IUPAC recommendations.

The final decade of the 20th century saw the activity of the Commission unabated. Robert Stepto succeeded to the Chairmanship in 1991, Máximo Barón became Secretary in 1998 and Michael Hess became Chairman in 2000. In the course of this decade, the graphical representation of polymer structures was addressed for the first time in 1994 [24], a revised and enlarged glossary of basic terms was published in 1996 [25], along with definitive documents dealing with the terminology of polymer aging and degradation (1998) [26] and non-ultimate mechanical properties (1998) [27]. Terminology concerned with liquid-crystal polymers was also published (2001) [28,29]. In the field of structure-based nomenclature, the Commission published recommendations covering regular double-strand polymers (1993) [30] and irregular single-strand polymers (1994) [31], and a revision of the Commission's 1975 rules for structure-based nomenclature [8] was completed (2002) [32]. In 1997, a document concerned with a new area, source-based nomenclature for non-linear macromolecules and macromolecular assemblies [33], was published. Documents on definitions relating to stereochemically asymmetric polymerizations [34] and the source-based generic nomenclature for polymers [35] were prepared in 2001.

## SUB-COMMITTEE ON MACROMOLECULAR TERMINOLOGY and SUB-COMMITTEE ON POLYMER TERMINOLOGY

With effect from 1<sup>st</sup> January, 2002, the Bureau and Council of the IUPAC decided to form a new Division of Chemical Nomenclature and Structure Representation (Division VIII) to deal with nomenclature in an integrated manner across all branches of chemistry. In keeping with this change and the change of the IUPAC to project-based funding, the Commission on Macromolecular Nomenclature decided to become the Sub-committee on Macromolecular Terminology of Division IV. Michael Hess and Máximo Barón remained as Chairman and Secretary, respectively. The development was timely as it reflected the change in the emphasis of the work the Commission was carrying out. Under the chairmanship of Robert Stepto and Michael Hess, the majority of projects had been

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concerned with terminology, related particularly to polymer and polymer-based materials. The trend continued, with recommendations on the terminology of polymer reactions and functional polymeric materials [36], and of polymer blends and composites [37] being published in 2004.

Richard Jones became Secretary in 2004. In the same year, the Macromolecular Division changed its name to Polymer Division and, in 2005, the subcommittee changed its name to the Subcommittee on Polymer Terminology. Richard Jones became Chairman in 2006 and Michael Hess became Secretary.

In keeping with the Subcommittee's mission, projects are planned that keep pace with the ever increasing variety of new polymer processes and polymeric materials and new classes of polymers. In 2006, recommendations on the terminology of polymers containing ionizable or ionic groups and of polymers containing ions [38] and, in 2007, jointly with the Inorganic Chemistry Division of the IUPAC, recommendations on definitions of terms relating to the structure and processing of sols, gels, networks and inorganic-organic hybrid materials [39] were published. Presently, in various stages of preparation are recommendations on kinetics and thermodynamics of polymerization, radical polymerizations with minimal termination – the so-called ‘controlled’ or ‘controlled/living’ radical polymerizations, terms relating to polymers in dispersed systems, biopolymers and biomedical polymers, and the thermal properties of polymers. In the field of nomenclature, working parties are preparing and completing recommendations concerned with the nomenclature of cyclic, hyperbranched, dendritic and rotaxane macromolecules, and with definitions of polymer class names. Finally, a general guide to polymer terminology and nomenclature is being prepared for publication on the IUPAC web site.

## TRANSLATIONS OF NOMENCLATURE AND TERMINOLOGY RECOMMENDATIONS

Although the nomenclature and terminology recommendations have all been published in English, those involved have purposefully pursued their further dissemination and discussion in other languages, including Chinese, Croatian, Czech, French, German, Italian, Japanese, Polish, Portuguese, Russian, and Spanish. Over the years, there has been no doubt about the global influence of the recommendations on the language of chemistry. A list of translations can be obtained from:

<<http://www.chem.qmul.ac.uk/iupac/bibliog/macro.html>>.

ROBERT B. FOX

*Secretary, IUPAC Commission on Macromolecular Nomenclature, 1973 – 1979*

NORBERT M. BIKALES

*Secretary, IUPAC Commission on Macromolecular Nomenclature, 1979 – 1987*

WILLIAM J. WORK

*Secretary, IUPAC Commission on Macromolecular Nomenclature, 1987 – 1997*

## **IUPAC POLYMER DIVISION**

**MÁXIMO BARÓN**

*Secretary, IUPAC Commission on Macromolecular Nomenclature, 1998 – 2001*

*Secretary, IUPAC Subcommittee on Macromolecular Terminology, 2002 – 2003*

**RICHARD JONES**

*Secretary, IUPAC Subcommittee on Macromolecular Terminology, 2004 – 2005*

*Secretary, IUPAC Subcommittee on Polymer Terminology, 2005*

**MICHAEL HESS**

*Secretary, IUPAC Subcommittee on Polymer Terminology, from 2006*

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