



## INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

18.4 Division IV Report to Council

Dr. Christine Luscombe

### I. Highlights and/or Executive Summary:

Despite the pandemic, the Polymer Division continued to be productive in its activities. As ever, in 2020, new projects were started and old projects were finished. Most projects led to publications, which included recommendations. New members arrived with some old members taking more of a backseat. Virtual meetings took place and future meetings were planned.

Here are some of our key achievements.

- 20 publications including 8 in *Pure and Applied Chemistry* and 9 in *Chemistry Teacher International*
- 10 conferences endorsed although we did not receive applications for endorsement after March 2020 due to the pandemic – see Appendix IV
- Running 31 projects
- Completion of 4 projects; started 2 new projects
- While our flagship conference, Macro 2020, was postponed, Macro 2020+ is back stronger than ever with >1000 participants registered for our upcoming hybrid event to be held in Jeju, South Korea May 2021.
- Elected our first four Emeritus Fellows, Michael Buback, Richard Jones, Pavel Kratochvil, Jung-Il Jin, whose details were published in *Chemistry International* and on the [IUPAC website](#). Specifically, for Prof. Kratochvil, we were able to organize a special 90<sup>th</sup> birthday celebration, despite the pandemic, and present him with a special IUPAC plaque (see [CI Oct 2020](#), p. 48)
- Shorter but more frequent virtual meetings held by task groups to accommodate the virtual era with participants in different timezones.
- Creation of 3 new YouTube videos by Marloes Peeters – [How to get involved with IUPAC](#); [A tribute to the father of the soft contact lens: Prof Otto Wichterle](#); [100 years in polymer science](#)
- Establishment of IUPAC Polymer Division [Google Scholar](#) to better enable us to monitor our impact (Figure 1). We were pleasantly surprised to see that some of our recommendations are extremely widely cited. Downside of the use of Google Scholar is



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that it has recognized that we are not an individual. As such, we do not appear in Google Scholar searches, nor does the page update itself with our papers. Specifically, it should be noted that not all of our publications from last year appear on the website.

- To celebrate the centenary of Macromolecular Science, an article has been written for *Chemistry International* and an article has been published in *Isr. J. Chem* (highlighted in last year's annual report).

As can be seen from the list above, the pandemic did not slow us down. We were determined to remain as productive as we could and fully embraced the virtual tools that were presented to us (Figure 2). One of the downsides of the pandemic is that it was challenging to develop new projects. However, the pandemic opportunity was that we were able to forge through with existing projects and tidy up loose ends. As a result, we currently have no overdue/overrunning projects.

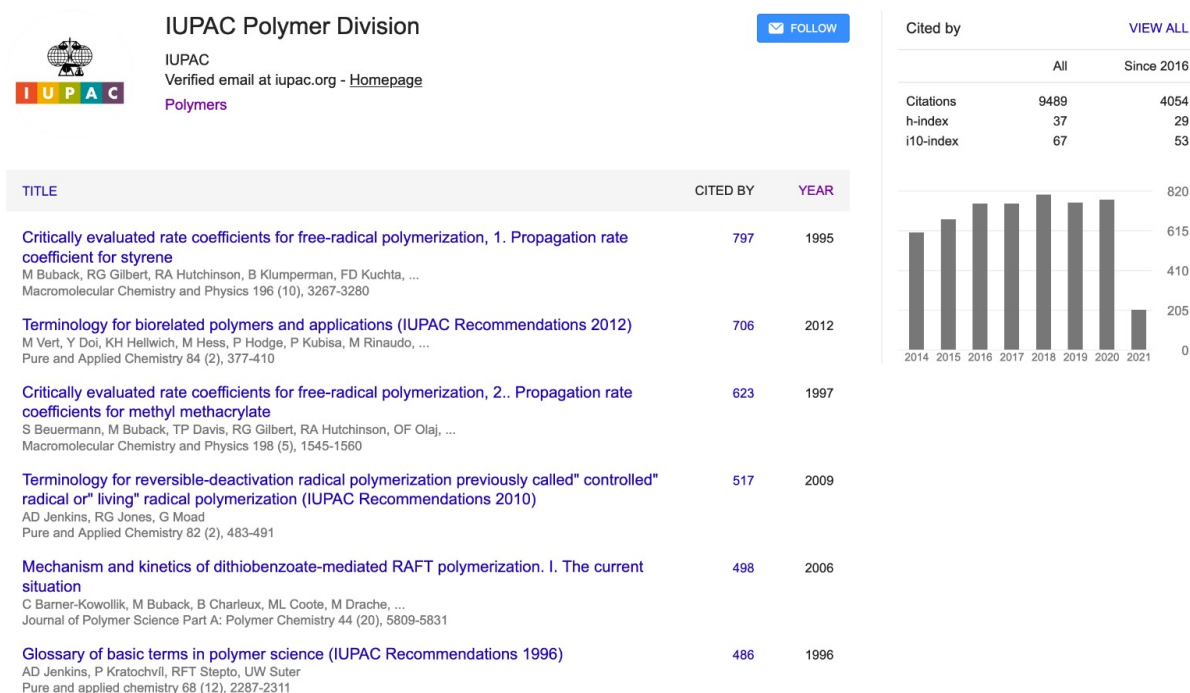


Figure 1. Screenshot of our Google Scholar page.



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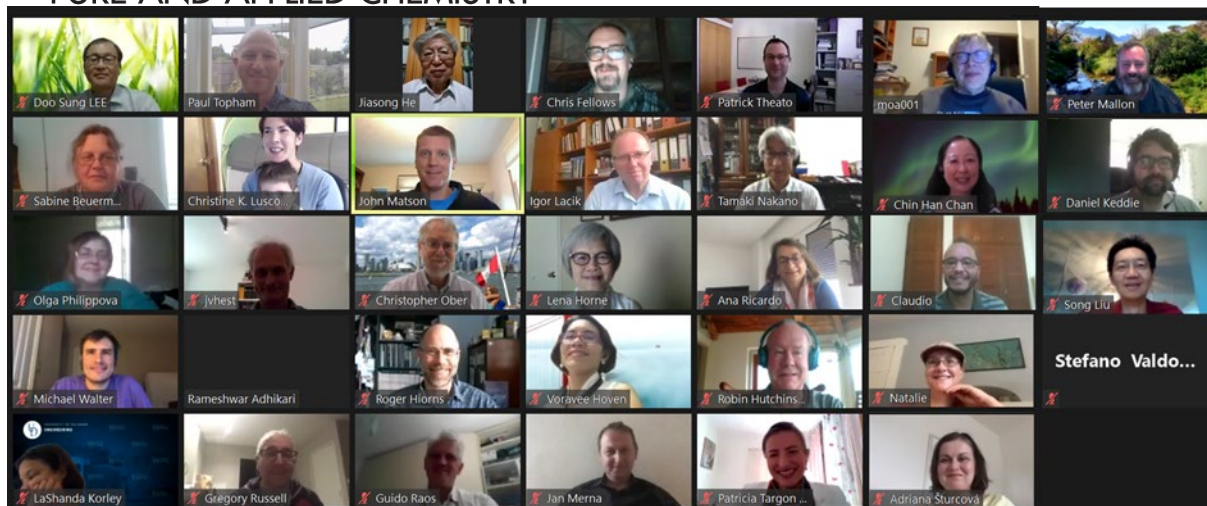


Figure 2. Screenshot of one of many zoom meetings that were held for our annual SPT/PD meetings in July 2020.

## II. Plans and priorities for this biennium, and beyond:

**Project with OPCW:** Division IV is leading a project proposal with OPCW on PPEs. We will be working with Division V, VI, VII, ICGSD, and chemical education as well. Specifically, WHO modeling estimated a requirement of 89 million medical masks for the COVID-19 response each month and 76 million examination gloves, leading governments to increase the production of plastics by 40% to meet rising global demand. Besides for medical purpose, due to increase in demand for online food and groceries during the pandemic, common plastic packaging waste such as PP, HDPE, LDPE, PET, and PS has increased.

The pandemic has altered waste generation dynamics; it is also not unlikely that another such event will occur in the future. Therefore, we want this project to be forward-looking and develop recommendations for the future. This project will look into manners of reducing waste and plastic/environmental pollution, use of novel materials, and dealing with biohazards. We also expect that this project will directly link into ongoing work with OPCW, as they are also tasked with the clean-up of contaminated areas.

**Gold Book project:** Division IV is forging ahead with the Gold Book updates using a project that was officially started in 2019 (2019-043-2-400). Meetings have occurred with Stuart Chalk to ensure that best practices are followed to make this a priority project for us.



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**Wikipedia projects:** Our Wikipedia projects were placed on hold for some time as we ran into copyright issues. However, with the help of Stuart Chalk and Leah McEwen, we have been able to come up with a work around for the copyright issue and will be able to reinstate the project soon.

**Ensuring diversity within the Division:** Promoting diversity in all its forms remains a priority for us. We did a significant amount of outreach to try and ensure that a diverse group of scientists were nominated for the upcoming elections.

Please see the appendices below for each subcommittee's reports.



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**Appendix I**

**Recent activities of the Polymer Division Subcommittee on Modeling of Polymerization Kinetics and Processes**

**Sabine Beuermann and Robin Hutchinson**

**March 2021**

**Objectives**

Modeling and mechanistic studies into free-radical polymerizations are important for science and industry, but often completely different model assumptions and parameter values are reported for ostensibly the same systems. The projects of the IUPAC Subcommittee “Modeling of Polymerization Kinetics and Processes” are to rectify this situation through international collaboration, by producing critically evaluated kinetic parameters, whose values are reliable and which can be used by the international polymer community. Reliable methodologies have been established by the IUPAC Subcommittee. Benchmark propagation rate coefficients,  $k_p$ , have been obtained for styrene, many methacrylates, butyl and methyl acrylate, vinyl acetate, and methacrylic acid by critical evaluation and also by independent experiments. These efforts were extended to termination rate coefficients, initiation rate parameters, and reversible-deactivation radical polymerization kinetics. Currently, the backbiting reaction in acrylate systems and the proper data evaluation in copolymerization are under consideration. In addition, a machine accessible databank for kinetic coefficients is being developed.

**Membership**

**Co-chairs:** S. Beuermann (Clausthal, D), R. A. Hutchinson (Kingston, CAN)

**Members:** C. Barner-Kowollik (Brisbane, AUS), M. Buback (Göttingen, D), M. Busch (Darmstadt TU, D), P. Castignolles (Western Sydney, AUS), M. Coote (Canberra, AUS), D. D’hooge (Ghent, BE), M. Drache (Clausthal, D), C. Fellows (Sydney, AUS), M. Gaborieau (Western Sydney, AUS), A. Goto (Kyoto, JP), M. Grady (Philadelphia, USA), Y. Guillaneuf (Marseille, FR), S. Harrisson (Toulouse, FR), A. M. van Herk (Singapore), J. P. A. Heuts (Eindhoven, NL), K. Hungenberg (Ludwigshafen, D), R. A. Hutchinson (Kingston, CAN), T. Junkers (Monash, AUS), A. Kajiwara (Nara, JP), B. Klumperman (Stellenbosch, ZA), I. Lacík (Bratislava, SK), P. Lacroix-Desmazes (Montpellier, FR), J. R. Leiza (San Sebastián, ES), P. Lovell (Manchester, UK), K. Matyjaszewski (Pittsburgh, USA), G. Moad (Melbourne, AUS), M. Monteiro (Brisbane, AUS), D. Moscatelli (Milan, IT), A. N. Nikitin (Moscow, RUS), S. Perrier (Sydney, AUS), G. T. Russell (Christchurch, NZ), E. Sato (Osaka City, JPN), D. A. Shipp (Clarkson, USA), J.-P. Vairon (Paris, FR), H. Vale (Ludwigshafen, D), P. Vana (Göttingen, D),



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J. Vorholz (Darmstadt, D), E. B. Wysong (Wilmington, USA), S. Yamago (Kyoto, JP), P. B. Zetterlund (Sydney, AUS), S. Zhu (Hamilton, CAN)

[total of 42 members from 16 countries]

The subcommittee has not had any meetings in the past year, other than smaller meetings organized to discuss specific ongoing projects. The following technical report was written for Pure and Applied Chemistry in 2018, but was not issued until November 2019.

*"Critically evaluated propagation rate coefficients for radical polymerizations: acrylates and vinyl acetate in bulk (IUPAC Technical Report)", R. A. Hutchinson, S. Beuermann, Pure Appl. Chem. 91(11), 1883–1888 (2019)*

No projects were completed since the start of 2019. Ongoing projects include:

1. Development of a Machine Accessible Kinetic Databank for Radical Polymerizations (Project 2019-045-1-400, T. Junkers)
2. Experimental methods and data evaluation procedures for the determination of radical copolymerization reactivity ratios (Project 2019-023-1-400, A. M. van Herk)
3. Critically evaluated rate coefficients for backbiting in acrylate radical polymerization (Project 2017-028-1-400, R. A. Hutchinson, T. Junkers)
4. Critically Evaluated Rate Coefficients for Radical Polymerizations of Styrene (Project 2013–047–1–400, leadership changed to K.-D. Hungenberg)
5. Critically Evaluated ESR (EPR) Spectra of Important Polymerization-Related Radicals (Project 2015–047–1–400, A. Kajiwara).
6. Critically Evaluated Rate Parameters for Chain-length-Dependent Termination Kinetics in Radical Polymerization of Styrene and Methyl Methacrylate (Project 2013–051–1–400, G. T. Russell)

### **Interdivisional project:**

7. Guidance for the Compilation, Critical Evaluation and Dissemination of Chemical Data (Project 2018-009-2-500, D. Shaw) R. A. Hutchinson participates as representative from this Subcommittee



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**Appendix II**

**Annual Report of IUPAC Subcommittee on Polymer Education - 2020**

**Goals**

The Subcommittee on Polymer Education was established in 2005 to bring existing educational activities under one roof and to emphasize both the importance of polymer education and the dedication of the IUPAC Polymer Division to this important field.

**Objectives**

The Subcommittee supports recurrent educational activities for polymer students from less-developed countries; it organizes educational sessions within the framework of the IUPAC Macro World Polymer Congress series and maintains the IUPAC Polymer Education Website.

**Summary of key activities from the second half of 2019-end of 2020**

2019-035-1-050	Special issue of Chemistry Teacher International in Polymer Sciences
2019-022-1-400	Educational Workshop in Polymer Sciences 2020
2018-038-1-400	Hands-on training on Wikipedia and Wikidata for application of IUPAC terms across Wikipedia
2017-019-2-400	An International Exercise-Based Syllabus in Polymer Chemistry
2015-032-2-400	Synchronizing Wikipedia: Polymer Definitions and Terminology
2012-027-3-400	Enhancing Educational Website for Polymer Chemistry

**Summary of status of each project**

The Subcommittee on Polymer Education has seven current projects.

**2019-035-1-050                      Special issue of Chemistry Teacher International in Polymer Sciences**

A joint project with the Committee on Chemical Education, this involves pairing academics in chemical education with researchers in polymer science to produce a special issue of the journal 'Chemistry Teacher International' (itself an IUPAC project, 2016-002-4-050) based on the content of educational workshops (2016, 2017, 2018 and 2020+) delivered at polymer conferences as part of other IUPAC projects (2015-057-1-400, 2016-033-1-400, 2017-029-2-400, 2019-022-1-400). The publication of the lecture notes covering topics of polymer synthesis



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(3 articles), polymer characterization (5 articles), polymer processing (2 articles) and polymer applications and others (3 articles).

### **2019-022-1-400 Educational Workshop in Polymer Sciences 2020+**

Following up on successful workshops held earlier at the MACRO 2018 meeting in Cairns (2017-029-2-400), the POLYCHAR meeting in Kuala Lumpur (2015-057-1-400) and the MACRO 2016 meeting in Istanbul (2015-057-1-400), it was planned to have a half-day educational workshop with a primary audience of postgraduate students at MACRO 2020 on Jeju. This workshop was rescheduled to 2021.

### **2018-038-1-400 Hands-on training on Wikipedia and Wikidata for application of IUPAC terms across Wikipedia**

A successful week of training was carried out in Milan with updates to 50+ polymer related pages on Wikipedia and work done with the aim of making the Polymer article a 'feature' article. A third edition of the course has been approved and funded by the PhD School of the Politecnico di Milano, and was held in Milano in 2019. Members of the task group learned more in-depth about Wikipedia and Wikidata, and will apply this to the creation/editing of a few high-quality Wikipedia pages on polymer-related subjects.

### **2017-019-2-400 An International Exercise-Based Syllabus in Polymer Chemistry**

Intended to create a resource for teachers and students in less developed countries, providing the 'skeleton' of a textbook with enough exercises to support an undergraduate course of study in polymer chemistry. A first draft of the syllabus is very close to completion.

### **2015-032-2-400 Synchronizing Wikipedia: Polymer Definitions and Terminology**

This project led over the past few years to numerous new and updated polymer-related Wikipedia pages containing IUPAC definitions and the follow up project 2018-038-1-400. The work is temporarily at a stop point as of July 2020.

### **2012-027-3-400 Enhancing Educational Website for Polymer Chemistry**

Dec 2019 update – The project was a major topic of discussion at the last meeting of the Subcommittee on Polymer Education in Paris and the task group plans to expand the site scope by providing an understanding of polymers and best methods for communication, aimed at students, educators, and the public.

Dec 2020 update – Dr Marloes Peeters -a former IUPAC Young Observer- contributed 3 videos.

- (1) she explains how she became involved in the IUPAC Polymer Division and her experiences with the wide range of activities with which IUPAC is involved.





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- (2) she retraces a brisk journey through the past, present, and future of synthetic polymers ('plastics').
- (3) she presents the story of the discovery by Otto Wichterle and Drahoslav Lim of poly(hydroxyethyl methacrylate) hydrogels and their use in making the first soft contact lenses.

### List of publications since second half of 2019

- (1) Penczek, S.; Pretula, J.; Slomkowski, S. Ring-opening polymerization. *Chemistry Teacher International* **2021**, doi:10.1515/cti-2020-0028
- (2) Halim, S. I. A.; Chan, C. H.; Apotheker, J. Basics of teaching electrochemical impedance spectroscopy of electrolytes for ion-rechargeable batteries – part 1: A good practice on estimation of bulk resistance of solid polymer electrolytes. *Chemistry Teacher International* **2021**, 10.1515/cti-2020-0011, 1-11, doi:10.1515/cti-2020-0011.
- (3) Luscombe, C. K.; Maitra, U.; Walter, M.; Wiedmer, S. K. Theoretical background on semiconducting polymers and their applications to OSCs and OLEDs. *Chemistry Teacher International* **2021**, 10.1515/cti-2020-0020, doi:10.1515/cti-2020-0020.
- (4) Bagheri, A.; Boniface, S.; Fellows, C. M. Reversible-Deactivation Radical Polymerisation: chain polymerisation made simple. *Chemistry Teacher International* **2021**, 10.1515/cti-2020-0025, doi:10.1515/cti-2020-0025.
- (5) Abetz, V.; Brinkmann, T.; Sözbilir, M. Fabrication and function of polymer membranes. *Chemistry Teacher International* **2021**, 10.1515/cti-2020-0023,
- (6) Moad, C. L.; Moad, G. Fundamentals of reversible addition–fragmentation chain transfer (RAFT). *Chemistry Teacher International* **2020**, 10.1515/cti-2020-0026, doi:10.1515/cti-2020-0026.
- (7) Vohlídal, J. Polymer degradation: a short review. *Chemistry Teacher International* **2020**, 10.1515/cti-2020-0015, doi:10.1515/cti-2020-0015.
- (8) Zainal, N. F. A.; Saiter, J. M.; Halim, S. I. A.; Lucas, R.; Chan, C. H. Thermal analysis: Basic concept of differential scanning calorimetry and thermogravimetry for beginners. *Chemistry Teacher International* **2020**, 10.1515/cti-2020-0010, 20200010, doi:10.1515/cti-2020-0010.
- (9) Nakano, T.; Pietropaolo, A.; Kamata, M. Chirality analysis of helical polymers. *Chemistry Teacher International* **2020**, 10.1515/cti-2020-0009, doi:10.1515/cti-2020-0009.



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The Chair of the Subcommittee is Chris Fellows (The University of New England, Australia - [cfellows@une.edu.au](mailto:cfellows@une.edu.au)) and the Secretary is Melissa Chin Han Chan (Universiti Teknologi MARA, Malaysia - [cchan\\_25@yahoo.com.sg](mailto:cchan_25@yahoo.com.sg)). There are 28 other members of the Subcommittee, representing Australia, Brazil, China (Beijing), China (Taipei), Czech Republic, Germany, Italy, Japan, Korea, Nepal, New Zealand, Qatar, Russia, South Africa, United Kingdom, and United States of America. Bimonthly Zoom meetings of the Subcommittee have been well attended over the past year, with almost all members attending at least one meeting.



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**Appendix III**

**Report from Subcommittee on Structure and Properties of Commercial Polymers**

Our subcommittee focuses on accumulating knowledge of structure and properties (mostly rheology and mechanical properties) of commercial polymers. With a balanced industry and academia memberships we are able to identify relevant challenges met in industry and to provide key solutions that will be beneficial for future materials development.

Due to the Covid-19 pandemic, we did not meet in person in the year 2020. Instead, we held an online subcommittee East Asian meeting on 20 Nov. 2020 with few scientific talks listed below. A total of 22 members from 4 countries participated the meeting. We discussed general matters of the subcommittee including results of projects (officially terminated

But yet active), feasibility studies of new proposals and so one.

Presentations (each 30 minutes: a talk of 25 min plus 5 min for discussions):

1. Prof. Chang-Sik Ha (Pusan National University), “Toughening poly(lactic acid) through reactive blending.”
2. Prof. Koh-hei Nitta (Kanazawa University), “Mechanical relaxation in polyethylene/paraffin mixtures”
3. Prof. Xia Dong (Institute of Chemistry, Chinese Academy of Sciences), “Long Chain Aliphatic Polyamides”
4. Prof. Prof. Andrzej Galeski (Polish Academy of Sciences), “UHMWPE data from European branch of IUPAC”

The list below summarizes publications from our subcommittee in year 2020:

1. Clive Bucknall, Volker Altstädt, Dietmar Auhl, Paul Buckley, Dirk Dijkstra, Andrzej Galeski, Christoph Gögelein, Ulrich A. Handge, Jiasong He, Chen-Yang Liu, Goerg Michler, Ewa Piorkowska, Miroslav Slouf, Iakovos Vittorias and Jun Jie Wu “[Structure, processing and performance of ultra-high molecular weight polyethylene \(IUPAC Technical Report\). Part 1: characterizing molecular weight](#)” Pure Appl. Chem. 2020; 92(9): 1469–1483
2. Clive Bucknall, Volker Altstädt, Dietmar Auhl, Paul Buckley, Dirk Dijkstra, Andrzej Galeski, Christoph Gögelein, Ulrich A. Handge, Jiasong He, Chen-Yang Liu, Goerg Michler, Ewa Piorkowska, Miroslav Slouf, Iakovos Vittorias and Jun Jie Wu “[Structure, processing and performance of ultra-high molecular weight polyethylene \(IUPAC Technical Report\). Part 2: crystallinity and supra molecular structure](#)” Pure Appl. Chem. 2020; 92(9): 1485–1501



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3. Clive Bucknall, Volker Altstädt, Dietmar Auhl, Paul Buckley, Dirk Dijkstra, Andrzej Galeski, Christoph Gögelein, Ulrich A. Handge, Jiasong He, Chen-Yang Liu, Goerg Michler, Ewa Piorkowska, Miroslav Slouf, Iakovos Vittorias and Jun Jie Wu “[Structure, processing and performance of ultra-high molecular weight polyethylene \(IUPAC Technical Report\). Part 3: deformation, wear and fracture](#)” Pure Appl. Chem. 2020; 92(9): 1503–1519
  
4. Clive Bucknall, Volker Altstädt, Dietmar Auhl, Paul Buckley, Dirk Dijkstra, Andrzej Galeski, Christoph Gögelein, Ulrich A. Handge, Jiasong He, Chen-Yang Liu, Goerg Michler, Ewa Piorkowska, Miroslav Slouf, Iakovos Vittorias and Jun Jie Wu “[Structure, processing and performance of ultra-high molecular weight polyethylene \(IUPAC Technical Report\). Part 4: sporadic fatigue crack propagation](#)” Pure Appl. Chem. 2020; 92(9): 1521–1536
  
5. Andrzej Galeski, Zbigniew Bartczak, Alina Vozniak, Andrzej Pawlak, and Rainer Walkenhorst "Morphology and Plastic Yielding of Ultrahigh Molecular Weight Polyethylene" *Macromolecules* 2020, 53, 6063–6077.
  
6. Ying Lu, Dong Lyu, Yujing Tang, Li Qian, Yanan Qin, Mingyue Xiang, Yongfeng Men "Effect of  $\alpha$ c-relaxation on the large strain cavitation in polyethylene" *Polymer*, 2020, 210, 123049.
  
7. Ruihua Lv, Yucheng He, Kefeng Xie and Wenbing Hu “Crystallization rates of moderate and ultrahigh molecular weight polyethylene characterized by Flash DSC measurement” *Polym Int* 2020; 69: 18–23.



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**Appendix IV**

**Report on conferences endorsed by PD IUPAC in 6/2019 - 3/2021**

**Igor Lacík, March 5, 2021**

The current situation has been heavily influenced by the COVID-19 pandemic; since it started (March 2020), no new Applications for IUPAC Endorsement has been filed.

Below is the list of Applications for IUPAC Endorsement reviewed in 2019 and 2020. They are either on hold or planned as virtual or hybrid events:

1. IUPAC Macro 2020+ 48th World Polymer Congress, May 16 – 20 2021, ICC Jeju, Korea (<http://www.macro2020.org/sub/catalog.php?CatNo=8>)
2. 23rd International Conference on Phosphorus Chemistry (ICPC23), May 31 - June 4 2020, Ningbo, China (<http://www.icpc23.org/>); the conference has been postponed to 2023 due to COVID-19
3. 44th International Conference on Coordination Chemistry (ICCC 2020), July 5 – 10 2020, Rimini, Italy (<https://www.iccc2020.com/>); the conference has been postponed to 28 Aug – 2 Sept 2022 due to COVID-19
4. 6<sup>th</sup> European Symposium on Photopolymer Science, 6-9 September 2020, Istanbul, Turkey (<http://www.esps2020.org/>); the conference has been postponed to Spring or Autumn 2022 due to COVID-19
5. IUPAC Macro 2022 49th World Polymer Congress, July 17 – 22 2022, Winnipeg, Manitoba, Canada (<https://iupac.org/event/48th-world-polymer-congress-macro2020/>)
6. 10<sup>th</sup> International Symposium “Molecular Order and Mobility in Polymer Systems”, 18-22 05 2020, Saint-Petersburg, Russia (<https://iupac.org/event/10th-international-symposium-on-molecular-order-and-mobility-in-polymer-systems/>); the conference has been postponed to May-June 2021 due to COVID-19
7. Polymers 2020: New Trends in Polymer Science: Health of the Planet, Health of the People, June 3–5 2020, Turin, Italy (<https://polymers2020.sciforum.net/>); the conference has been postponed to 25-27 May 2022 due to COVID-19



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8. 13th Conference on Polymer-Solvent Complexes and Intercalates, November 10-13 2020, Toyonaka, Japan, (<http://www.chem.sci.osaka-ac.jp/graduate/mms/polysolvat13/>); the conference has been postponed to the autumn 2021 due to COVID-19
9. Italian-French International Conference on Magnetic Resonance, September 21-24 2020, Milan, Italy (<https://iupac.org/event/italian-french-international-conference-on-magnetic-resonance/>); the conference has been postponed to September 2021 due to COVID-19
10. POLY-CHAR 2021 World Forum on Advanced Materials and Short Course on Polymer Characterization, January 25 – 29 2021, Auckland, New Zealand; the conference has been postponed to 17-20 January 2022 due to COVID-19



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**Appendix V**

**IUPAC POLYMER DIVISION (IV)**

**Report on Subcommittee on Polymer Terminology (SPT) for the Year to March 2021**

The 2020 meeting of the Subcommittee was held between the 29<sup>th</sup> of June and 2<sup>nd</sup> of July in an online format. Despite the challenges of holding the meeting online due to the ongoing COVID-19 pandemic, the meeting was very well attended. Around 46 members were present during the several days of the meeting. The following members and observers participated: Prof. Volker Abetz (VA, Germany), Dr. Rameshwar Adhikari (RA, Nepal), Prof. Blair Brettmann (BB, USA), Prof. Patricia Targon Campana (PTC, Brasil, Observer), Prof. Melissa Chan (MC, Malaysia), Mr. Jiazhong Chen (JC, USA), Prof. Wesley S. Farrell (WF, USA), Prof. Chris Fellows (CF, Australia), Dr. Francesca Giuntini (FG, UK), Prof. Monika Gosecka (MG, CZ, Observer) Prof. Carlos F. O. Graeff (CG, Brazil), Dr. Daniebelle Haase (DH, USA), Prof. Jiasong He (JH, China/Beijing), Prof. Michael Hess (MH, Germany), Dr. Roger C. Hiorns (RCH, France - Chair) Prof. Lena Horne (LH, Canada), Prof. Wenbing Hu (WH, China/Beijing) Prof. Richard “Dick” Jones (RGJ, UK), Dr. Daniel Keddie (DK, UK), Prof. LaShanda Korley (LK, USA), Prof. Christine Luscombe (CKL, USA), Dr. Mario Malinconico (MM, Italy), Prof. Peter Mallon (PM, South Africa), Prof. John B. Matson (JBM, USA - Secretary), Prof. Stefano Valdo Meille (SVM, Italy), Dr. Jan Merna (JM, Czech Republic), Dr. Yoko Miyasaka (YM, Japan, Observer), Dr. Graeme Moad (GM, Australia), Prof. Tamaki Nakano (TN, Japan), Prof. Chris Ober (CO, USA), Dr. Marloes Peeters (MP, UK), Prof. Stan Penczek (SP, Poland), Prof. Olga Philippova (OP, Russia), Prof. Guido Raos (GR, Italy), Prof. Greg Russell (GTR, New Zealand), Prof. Cláudio dos Santos (CdS, Brazil), Prof. Stan Slomkowski (SS, Czech Republic), Prof. Natalie Stingelin (NS, UK), Dr. Adriana Sturcova (AS, Czech Republic), Prof. Patrick Théato (PT, Germany - Secretary), Prof. Paul D. Topham (PDT, UK), Dr. Lydia Sosa Vargas (LSV, France), Prof. Jiri Vohlidal (JV, Czech Republic), Prof. Michael Walter (MGW, USA), Dr. Andrey Yerin (AY, Russia), Prof. Myung-Han Yoon (MHY, Korea). Apologies were received from Prof. J.-L. Gardette (JLG, France) and Prof. Michel Vert (MV, France).

The SPT website has been continually updated, and the minutes of past meetings are rapidly published at:

[https://iupac.org/who-we-are/committees/committee-details/?body\\_code=401](https://iupac.org/who-we-are/committees/committee-details/?body_code=401)

The minutes of the 2020 SPT meetings have been circulated and are pending SPT approval (see attachment).



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The role of SPT is to produce documents that define terms in polymer science and to make recommendations on the nomenclature of polymers on behalf of Division VIII. Its work is used greatly throughout academia, secondary and tertiary educational institutes, and perhaps most importantly in industry.

Many projects have been progressed throughout the year by electronic exchanges using e-mail and Skype or similar video call technologies. Yet, it is the understanding of SPT that face-to-face meetings are very important, as they allow projects to advance much more quickly than by electronic communications alone. The process of in-depth discussion and debate between the members and observers is intrinsic to developing viable, useful systems of terminology and nomenclature. Further, integration of observers is most effective during face-to-face meetings. Having that said, the COVID-19 pandemic has impacted our work, as it was impossible for us to meet in 2020 in Jeju. The decision was made to hold the SPT meeting completely online, and progress on projects was good, despite the challenges to cope with different time zones to bring members from different countries together. As such, face-to-face meetings are much more efficient, when all members are present in one location. It is therefore very much hoped that future meetings will occur again in person, so that we can rapidly advance our work. That said, warm thanks to our members and team leaders, who have been exceptional in driving forward projects as far as they can electronically, often under difficult personal circumstances.

Nevertheless, the decision has been made that the 2021 SPT meeting in August will be held online again, due to the uncertainty in the ongoing COVID-19 pandemic. Details of the agenda are currently under development.

### **PROJECTS**

In the period covered by this report, the Subcommittee has worked on 26 projects, of which five projects (Alain Fradet (Dendritic), Stan Slomkoski (Keywords), Michel Vert (Lactic), Phil Hodge (Web-Guide), Jiazhong Chen (Stars1)) have been concluded successfully. Another four projects are in earnest preparation for submission for funding.

The five finished projects, producing documents now published, and detailed below, give good examples of the range of our work. Three papers were published on the terminology and nomenclature of polymers. Two other papers show our work in helping the polymer communities publish their work, one being on keyword listings and another guiding authors so that IUPAC terminology and nomenclature is more accessible.

This considerable level of activity also meant that we were starting to come close to not having enough projects to work on! We are particularly grateful to the new president, Christine Luscombe, for her strong support of new projects that were submitted this year. Additionally, all task group leaders should be managing their projects effectively during the current pandemic.





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The new projects (Electro, Nano-nano, DE, and Brief Guide Revision) are very important for the polymer community.

Here is the list of SPT projects:

### 1. The following projects delivered the following publications or have been accepted for publication:

- **2001-081-1-800** (DENDRITIC, Fradet) ‘Terminology and structure-based nomenclature of dendritic and hyperbranched polymers (IUPAC Recommendations 2017)’, A. Fradet,\* J. Chen, K.-H. Hellwich, K. Horie, J. Kahovec, W. Mormann, R. F. T. Stepto, J. Vohlidal, E. S. Wilks, *Pure & Appl. Chem.*, **2019**, 91(3), 523-561. <https://doi.org/10.1515/pac-2016-1217>
- **2010-036-1-400** (KEYWORDS, Slomkowski) ‘List of keywords for polymer science (IUPAC Technical Report)’, S. Slomkowski,\* C. M. Fellows, R. C. Hiorns, R. G. Jones, P. Kubisa, C. K. Luscombe, T. Nakano, G. T. Russell, C. G. dos Santos, C. Scholz, N. Stingelin, M. G. Walter, *Pure & Appl. Chem.*, **2019**; 91(6):997-1027. <https://doi.org/10.1515/pac-2018-0917>
- **2014-033-1-400** (LACTIC, Vert) ‘Nomenclature and terminology for linear lactic acid-based polymers (IUPAC Recommendations 2019)’ M. Vert,\* J. Chen, K.-H. Hellwich, P. Hodge, T. Nakano, C. Scholz, S. Slomkowski, J. Vohlidal, *Pure & Appl. Chem.*, **2020**; 92(1):193-211; <https://doi.org/10.1515/pac-2017-1007>
- **2008-020-1-400 (WEB-GUIDE, Hodge)** ‘A concise guide to polymer nomenclature for authors of papers and reports in polymer science and technology (IUPAC Technical Report)’, P. Hodge\*, K. -H. Hellwich, R. C. Hiorns, R. G. Jones, J. Kahovec, C. K. Luscombe, M. D. Purbrick and E. S. Wilks, *Pure Appl. Chem.* 2020; 92(5): 797–813; <https://doi.org/10.1515/pac-2018-0602>
- **2013-031-3-800** (STAR) ‘Structure-based nomenclature for irregular linear, star, comb and brush polymers (IUPAC Provisional Recommendations)’, J. Chen\*, E. S. Wilks\*, A. Fradet, K.-H. Hellwich, R. C. Hiorns, T. Nakano, C. G. dos Santos, P. Theato, *PAC-REC-2020-0103.R2* accepted.

### 2. The following projects are currently in public review:

- **2009-047-1-400** (STEREOCHEM) *Definitions and notations relating to stereochemical aspects in polymer science* – Hellwich & Moad



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- **2012-001-1-400** (NANO-LITHO) *Terminology of nanomaterials and nanotechnology in polymer science*, Ober & Jones through the document, *Terminology of Polymers in Advanced Lithography*
- **2014-034-2-400** (CAR) *Nomenclature for polymeric carriers bearing chemical entities with specific activities and names* – Vert
- **2006-028-1-400** (FIELD) *Terminology for conducting, electro-active and field-responsive polymers* – Vohlidal
- **2010-007-1-400** (CHAIN) *Terminology for chain polymerization* – Luscombe & Moad

### 3. The following projects are working:

- **2012-048-3-400** (B-TERMS) *A brief guide to polymer terminology* – Hiorns & Vohlidal
- **2011-035-1-800** (TINCOPS) *Terminology and nomenclature of inorganic and coordination polymers – a extended revision of Nomenclature for regular single-strand and quasi-single-strand inorganic and coordination polymers (1984)\** - Jones
- **2014-014-1-400** (MODSIM) *Terminology for Modeling and Simulation of Polymers* - Meille
- **2015-013-1-400** (POLY) *Brief Guide to Polymerization Terminology* – Luscombe
- **2015-014-1-400** (SEMIS) *Guide (and Brief Guide) to Polymer Semiconductors* – Walter
- **2015-032-2-400** (WIKI) *Synchronizing Wikipedia: Polymer Definitions and Terminology* – Hess
- **2015-049-1-400** (CHAR) *Brief Guide to the Characterisation of Polymers* – Topham
- **2015-050-1-400** (ULTIMATE) *Definition of Terms Relating to the Ultimate Mechanical Properties of Polymers* – Adhikari
- **2016-050-3-400** ( $\mu$ STRUCTURE) *Definition of Terms Pertaining to Polymers in the Solid State: Molecular Arrangement from the Nano- to the Micrometer Scale* - Stingelin
- **2017-039-2-800** (GRAPHIC) *Graphical Representation of Polymer Structures* – Hellwich
- **2018-033-1-400** (ADDIPLAST) *Additives intended to promote the degradation of polyolefin-based thermoplastic materials* – Malinconico
- **2019-041-3-400** (SEQ) *Nomenclature of Sequence-Controlled Polymers* – Théato



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- **2019-043-1-400 (GOLDEN)** Gold Book Updates for Polymers - dos Santos
  - **2019-010-2-400 (AGGREGATES)** Terminology of Polymer Aggregates – Nakano
  - **2019-027-1-400 (OVER)** Basic classification and definitions of polymerization reactions - Matson
- 4. The following projects have recently been accorded funding or extension or both:**
- **2019-036-1-800 (STARS2)** Structure-based nomenclature for irregular linear, star, comb and brush polymers with different types of constitutional repeating units (CRU) – Chen
- 5. Projects submitted or close to submission to IUPAC for funding:**
- **2020-XXX-X (ELECTRO)** Electronic Formulae – Yerin
  - **2020-XXX-X (Nano-Nano)** Yoon & Jones
  - **2020-XXX-X** Revision of the Brief Guide to Polymer Nomenclature - **Hiorns**, Boucher, Chen, Duhlev, Fradet, Hellwich, Jones, Nakano, Vert
  - **2020-XXX-X (DE)** Degradation of polymers – Gardette
  - **2021-XXX-X (UNITED)** – Patricia
  - **2021-XXX-X (SUPRA)** - Monika

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John B. Matson, Patrick Theato

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\* Division VIII project pursued under the auspices of SPT.