

IUPAC Subcommittee on Structure and Properties of Commercial Polymers—East Asia Research Meeting

by Jiasong He

On 15-16 December 2023, IUPAC Subcommittee on Structure and Properties of Commercial Polymers East Asia (EA) Research Meeting held the annual meeting—No. 81A—in Guangzhou, China. Chaired by Koh-hei Nitta (Kanazawa University, Japan) and hosted by Yongfeng Men (Changchun Institute of Applied Chemistry, Chinese Academy of Sciences, China), this was a face-to-face meeting after the three-year pandemic period, with only 4 members attending online. In total there were 41 participants from 3 countries (China, Japan, and Korea), including 19 observers. Indicating a boost in the near future, its scale was the largest one in the history of the EA Research meeting, especially with observers from industry such as PetroChina (Beijing), CHN Energy, SABIC (Shanghai), ExxonMobil (Shanghai), BASF (Shanghai), Kingfa Co., and Covestro (Shanghai). These observers will become full members of this serial research meeting if these observers and their organizations are interested in this platform and join actively. This trend will enhance the well-balanced industry vs. academia

membership, working with like-minded scientists from often competitive organizations. With industrial support and participation, IUPAC Polymer Division boasts a unique feature of industrial involvement among the eight divisions of IUPAC. The group photo (Figure 1) was taken at the meeting site: Huangpu Institute of Materials, Aviation Tire Science Center, Huangpu District, Guangzhou, China.

Annual meetings

IUPAC East Asia Research Meeting originated from IUPAC Working Party IV.2.1 “Structure and Properties of Commercial Polymers,” a part of the Macromolecular (renamed Polymer in 2004) Division of IUPAC. The Working Party has existed since 1963, first as part of the IUPAC Commission on Macromolecules and then, since 1965, as part of the Macromolecular Division. From 1973 to 1999, the Working Party operated within the Commission on Characterization and Properties (IV.2) of Division IV; and since 2004 it has operated as Subcommittee on Structure and Properties of Commercial Polymers of IUPAC Polymer Division (IV).

In the period between 1963 and 1980 the Working Party held 37 meetings, all of which were in Western Europe. In addition, two regional sub-groups were established in the early 1980s. The first was established in Japan (the East Asian Sub-Group) and benefited



Figure 1: IUPAC East Asia Research Meeting 81A (2023), hosted by Y. Men and chaired by K. Nitta (first row from right: the eighth and ninth, respectively).

Meeting number	IUPAC Number	Year	Venue	Chair	Secretary
1	EA WP 4.2.1.1*	1986	Tokyo, Japan	A. Nakajima	T. Masuda
2	EA WP 4.2.1.1	1987	Kyoto, Japan	A. Nakajima	T. Masuda
3	EA WP 4.2.1.1	1988	Kyoto, Japan	A. Nakajima	T. Masuda
4	EA WP 4.2.1.1	1989	Seoul, Korea	A. Nakajima	T. Masuda
5	EA WP 4.2.1.1	1990	Kobe, Japan	A. Nakajima	T. Masuda
6	EA WP 4.2.1.1	1991	Beijing, China	A. Nakajima	T. Masuda
7	EA WP 4.2.1.1	1992	Katata-Shiga, Japan	A. Nakajima	T. Masuda
8	EA WP 4.2.1.1	1993	Beijing, China	A. Nakajima	T. Masuda
9	EA WP 4.2.1.1	1994	Osaka, Japan	R. Qian	T. Masuda
10	EA WP 4.2.1.1	1995	Shanghai, China	R. Qian	T. Masuda
11	EA WP 4.2.1.1	1996	Seoul, Korea	T. Masuda	-
12	55A**	1997	Himeji, Japan	T. Masuda	-
13	56A	1998	Kyoto, Japan	T. Masuda	-
14	57A	1999	Changchun, China	T. Masuda	-
15	58A	2000	Taejon, Korea	S. C. Kim	D. S. Lee
16	59A	2001	Naha, Japan	S. C. Kim	D. S. Lee
17	60A	2002	Beijing, China	S. C. Kim	D. S. Lee
18	62A***	2004	Jeju, Korea	S. C. Kim	D. S. Lee
19	62B	2004	Kyoto, Japan	S. C. Kim	D. S. Lee
20	63A	2005	Beijing, China	J. He	Q. Yan
21	64A	2006	Busan, Korea	J. He	X. Wang
22	65A	2007	Kanazawa, Japan	J. He	X. Wang
23	66A	2008	Ningbo, China	J. He	X. Wang
24	67A	2010	Jeju, Korea	J. He	C. Liu
25	68A	2010	Kyoto, Japan	T. Takigawa	K. Urayama
26	69A	2011	Kunming, China	T. Takigawa	K. Urayama
27	70A	2012	Jeju, Korea	T. Takigawa	K. Urayama
28	71A	2013	Ube, Japan	T. Takigawa	K. Urayama
29	72A	2014	Luoyang, China	C. S. Ha	S. H. Lim
30	73A	2015	Busan, Korea	C. S. Ha	S. H. Lim
31	74A	2016	Hikone, Japan	C. S. Ha	S. H. Lim
32	75A	2017	Xi'an, China	C. S. Ha	S. H. Lim
33	76A	2018	Busan, Korea	Y. Men	Y. Tang
34	77A	2019	Ishigaki Island, Japan	Y. Men	Y. Tang
35	78A	2020	Virtual	Y. Men	Y. Tang
36	79A	2021	Virtual	K. Nitta	K. Urayama
37	80A	2022	Virtual	K. Nitta	K. Urayama
38	81A	2023	Guangzhou, China	K. Nitta	K. Urayama

Table 1. East Asia (EA) Research Meetings

Notes:

* IUPAC Macromolecular Division (IV) Commission on Polymer Characterization and Properties (IV.2) Working Party on Structure and Properties of Commercial Polymers (IV.2.1) Meeting in East Asia (IV.2.1.1) (IUPAC WP IV-2-1-1) since 1986

** IUPAC Macromolecular Division (IV) Commission on Structure and Properties of Commercial Polymers (IV.2) Research Meeting in East Asia since 1997 (meeting number with the letter A for Asia)

*** IUPAC Macromolecular (Polymer) Division (IV) Subcommittee on Structure and Properties of Commercial Polymers (IV.2) East Asia Research Meeting since 2004



Figure 2: The 4th East Asia Research Meeting, June 1989, Seoul, Korea

from new members from Japan, China, and Korea. The second was an Eastern European Sub-Group with new members. The motivation for the formation of these sub-groups was to expand membership on a global basis and to ease travel (restricted by cost or political conditions). Each sub-group established its own projects and reported to the main Working Party.

In this way the history of the East Asia Research Meeting started in 1986. The history and development in the following years, together with the history, output, and future prospects of the IUPAC Working Party on Structure and Properties of Commercial Polymers, have been summarized by D. Royston Moore and H. Martin Laun in 2004 [1]. The present article reports the then-followed process of the East Asia Research Meeting for extending the above-cited report.

In our archived records, the earliest group photo of the East Asia Research Meeting was taken in 1989 in Seoul, Korea (Figure 2).

Since 1998 East Asia (EA) Research meetings have been held annually and hosted by member countries in turn, *i.e.* Japan, China, and Korea. Table 1 listed the serial EA meetings, with the serial numbers of the Subcommittee meetings. For economic, convenience, and practical reasons, EA Research Meetings were always held before or after some large-scale international academic conferences. Almost all EA members attended these annual EA meetings, benefited partly

by easy travel and entrance. Some EA members also attended the Subcommittee annual meetings held in Europe, which is recorded in the minutes of Subcommittee annual meetings. Celebrating the 50th anniversary (1963-2013), the Subcommittee held a jubilee meeting with participants from EA Research Meeting in 2013 in London (Figure 3), the venue for the first meeting of the Working Party.

Projects

Each member of the East Asia Research Meeting is entitled to put forward proposals for new projects. Any commercial polymers which structure and properties have academic interests can be the project focus. The projects should have a particular scientific target and be mainly experimental in nature. Projects are structured to accommodate value in application, need and scientific novelty. A potential project starts with a feasibility study. After realizing sufficient participation, the feasibility studies are converted into project proposals, in which the outline and goal of the work, the supplier of the material, the contributors from inside and outside of the Research Meeting and the coordinators are defined. After cooperatively conducting feasibility studies among members not only in East Asia and in the main body of the Subcommittee as well, a trend will be shown valuable or not. If the conclusion is yes, then an application for a IUPAC project

Project Place

will be agreed by the Meeting. Application forms for IUPAC projects should be distributed among members who are interested in and join the feasibility studies, followed by submitting to IUPAC via the Polymer Division. If interested in the projects of the main body of the Subcommittee and the East Asia Research Meeting, members from both parts can join any projects and publish results jointly or independently.

An approved project on “Structure and properties of cyclic olefin copolymers (COC)” was proposed and coordinated by Sung Chul Kim (project 1999-039-1-400). With the benefit of a IUPAC project, three-series commercially available cyclic olefin copolymers (COC) with their glass transition temperatures T_g 's spanning over one hundred degrees centigrade were collected and then distributed among the interested members. The influences of the chemical composition and microstructure on the degradation behaviors were scrutinized [2]. The relationship of their chemical structure and glass-transition temperatures and surface characteristics were investigated [3]. Cooperating with the European members, morphology and micromechanical behavior of these COC were studied [4]. The focus was also on relating the chemical structure of COCs to dynamic birefringence [5], and the dependence of rheological zero-shear viscosity and steady-state compliance on molecular weight between entanglements [6].

In the project “Effects of side-chain branching on the processability of commercial polycarbonates” (project 421-35-97), the effects of long chain branching with a

focus on its processability in blow molding, extrusion and injection molding, as well as on its solid-state properties, were the subjects. This collaborative project was coordinated by Masaaki Takahashi, Kazuo Sato and Toshio Masuda. The study was initiated and carried out mainly by the East Asia members of the Working Party [7], and there were also contributions from European members.

A project “Structure and properties of polyester elastomers composed of poly(butylene terephthalate) and poly(ϵ -caprolactone)” was proposed and coordinated by Toshikazu Takigawa (project 2002-052-1-400).

A project “Structure and properties of polymer/clay nanocomposite” was proposed by Sung Chul Kim and organized jointly with Koh-hei Nitta (project 2003-051-1-400). The structural, morphological and thermal properties of polyamide-6 and polyamide-6/66 clay nanocomposites were explored [8].

A project on “Relation between rheological properties and foam processability for polypropylene,” was proposed and coordinated by Masayuki Yamaguchi (project 2010-029-3-400). Morphology development of polytetrafluoroethylene (PTFE) caused by applied flow history in molten isotactic polypropylene (PP) was investigated [9]. Rheological properties of polymer composites with flexible fine fibers were studied by employing poly(lactic acid) (PLA) containing small amount of PTFE fibers and so on [10].

A focus was on “Microstructure and properties of thermotropic liquid crystalline polymer blends and composites”, which was proposed as an IUPAC project and



Figure 3: Jubilee meeting (50th anniversary) in London, taken on The London Eye, 9 April 2013.

coordinated by Jiasong He (project 2004-044-2-400). Rheological hybrid effect was explored in fiber-filled polymer melts, caused by thermotropic liquid crystalline polymers [11].

EA members also joined projects proposed and conducted in the Subcommittee, such as the project of “Microstructural, rheological and mechanical properties of (un)compatible PA6/ABS blends with and without compatibilizers” (project 2005-023-2-400) proposed and coordinated by Ulrich Handge [12].

Aimed to develop improved methods for characterizing ultra-high molecular weight polyethylene (UHMWPE) mouldings, and hence to improve quality assurance procedures for hip and knee prostheses, an IUPAC project on “Structure, processing and performance of ultra-high molecular weight polyethylene” was proposed (project 2010-019-1-400). Chaired by Clive Bucknall, this project had a well-balanced team consisting of industrial and academic members. Their expertise ranged from molecular weight (MWt) determination and electron microscopy to micro-cracking and wear of joints, with strong backgrounds in UHMWPE research. Samples of Ticona 3 HMWPE grades, with MWts of 0.4, 5 and 9 MDa, as both powder and standardized mouldings were collected and distributed among the group members. Team members addressed problems of monitoring changes in molecular weight, crystallinity, crystal morphology, interfacial reptation and entanglement during moulding, and the effects of these changes on strength and wear resistance. Others observed and quantified the changes during processing [13-17].

Randomly copolymerized polypropylene is widely used for food packaging. However, its soluble fraction (the solubles) will migrate to the package surface and contaminate the food. A IUPAC project was focused on evaluating the relationship between the macromolecular structure and the performance of transparent polypropylene with low soluble contents. This current project “Structure and properties of transparent polypropylene with very low solubility” (project 2016-028-1-400) was proposed and coordinated by Jinliang Qiao, and had publications [18-21].

More recently, EA members also joined another project “Thermoplastic starch-based materials: properties and characterization” proposed and coordinated by Miroslav Slouf and Elvira Vidovic (project 2023-015-2-400). The objectives include the optimization of starch plasticization, and deeper understanding of the relationships between structure and properties of starch-containing materials.

Feasibility studies

Conventionally IUPAC projects have limited lifetimes of about 3 years. However, based on the experience of the Working Party, this period is usually not adequate for voluntary and unfunded joint experimental work. A period of 5 years or longer is more realistic. And then for some feasibility studies, their periods may span several years. For some feasibility studies, during screening measurements and before applying for IUPAC project, valuable results have been obtained and reached journal publications. In this situation the feasibility studies are mentioned in the acknowledgement of publications, instead of their IUPAC project numbers. Now in the East Asia Research meeting, there are feasibility studies as follows. They have interested members and remain in the step of screening measurements and exploring potential and novelty.

- “Structure and properties of long chain-branched polypropylene” (proposed by Zhaohui Su).
- “Structure and properties of linear and branched polyethylene blends” (proposed by Yongfeng Men).
- SINOPEC commercial polymers: anti-bacterial and anti-mildew PP resin or PET fiber (proposed by Jinliang Qiao) [22].
- Hyosung commercial polymer: polyketone – new green polymeric material (proposed by Chang-Sik Ha) [23].
- Structure and properties of PLA (proposed by Peng Chen).
- Broadband viscoelastic measurements (proposed by Tadashi Inoue).
- Citrate ester plasticizers (proposed by Masayuki Yamaguchi).
- Effect of hydrogen-bonding organization on crystal form transition of PA1012 and its block copolymers (proposed by Xia Dong).
- Butyl rubber and its halogenate derivatives (proposed by Toshio Tada and Kenji Urayama).

The bright future of the EA Research Meeting relies on the continuous and active involvement of young generations. I believe that with more young members this Research Meeting will make more contributions to the understanding of the structure and properties of commercial polymers, and their effective production and beneficial applications.

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