

**INSTITUTE FOR POLYMER RESEARCH (IPR)
UNIVERSITY OF WATERLOO
WATERLOO, ONTARIO N2L 3G1**

NEWSLETTER 2021

1. NOTE FROM PROFESSOR JEAN DUHAMEL, IPR DIRECTOR

Like all of us, the IPR is following the covid roller coaster one wave after another and the IPR continues its work in a mainly on-line fashion. This meant that, for the second time in a row, the IPR symposium had to be held on-line. While all of us are longing for a return to the lively in-person symposia of old, we were fortunate that the MS-Teams platform used for the symposium worked well and all presenters were able to deliver their research results in a clear and effective manner. This was the 43rd iteration of the IPR Symposium. Among the highlights of the symposium were our two Keynote Speakers, Professor Eduardo Vivaldo-Lima from UNAM (Mexico) and Dr. Valerie Farrugia from Xerox (Canada), who talked about the “Development of Biorefining Processes from Lignocellulosic Processes” and “2D and 3D Printing of Engineered Particles”, respectively. The two 2021 IPR awards were also handed out during the symposium to Xiaotong Cao and Damin Kim, who were PhD candidates in Prof. Feng’s and my laboratories, respectively. Xiaotong gave a very nice presentation on the “Removal of Phenolic Compounds Using Poly(ether-block-amide) Membranes” and Damin’s presentation on the “Compressibility of Amylopectin Characterized by Pyrene Excimer Formation” was well-received. In terms of student presentations, the 2021 IPR Symposium boasted 30 presentations, an all-time record, and a clear illustration of the tremendous level of research activity within the IPR laboratories despite the restrictions imposed on us by the Covid pandemic! The Symposium was also well attended by colleagues from both Academia and Industry.

The success of the on-line delivery of the 2021 IPR Symposium brings into question whether future IPR Symposia should retain some on-line component. With this in mind and after consultation with my IPR colleagues, it was decided that the 2022 IPR Symposium will offer a hybrid mode of delivery, with students giving presentations in-person, which will be broadcast through MS-Teams. This mode of delivery for the presentations should offer the most flexible options for attending the symposium, either in-person or virtually. Of course, in case the Omicron or other covid variants remain a health issue, the symposium will revert to a purely on-line mode, as we have done in the past two years.

Beside the symposium, our students continued to contribute informative presentations as part of our IPR Student Presentation Series. Damin Kim and Janine Thoma (Chem.) from my group gave a lecture on the “Structure, Properties, and Applications of some Polysaccharides” and on “PEGylation and Polymeric Bottle Brushes for Drug Delivery”, respectively. The third speaker for this series was Sara Xu from Prof. Michael Tam’s laboratory, who gave a lecture on “Emulsion Polymerization and Characterization of Polymeric Nanogels”. The IPR Students Presentations are always very well attended and trigger interesting discussions among attendees.

2021 marked also the retirement of my dear Chemistry colleague, Prof. Mario Gauthier. Mario’s imposing research activity in the synthesis and characterization of complex macromolecular architectures, most notably of arborescent polymers, which he was the first to synthesize in 1991, made him a force to reckon with in the Department of Chemistry and the IPR. During my 25 years at Waterloo, his vibrant laboratory manned with 15 – 20 students and postdocs has always been buzzing with activity, supported by an impressive array of instruments, which he always made available to colleagues. His broad and deep knowledge on anything ranging from synthetic, physical, and macromolecular chemistry, but also including electronics (!), his excellent understanding of the inner workings of our administration, and his broad range of connections reaching as far as China made him an invaluable source of inspiration and a great mentor in my early days at Waterloo. Mario leaves behind a big hole in the Department of Chemistry and the IPR, where his students

made important contributions year after year through numerous presentations, particularly during the IPR Symposia. We are thankful that Mario remains associated with the IPR even in retirement and we certainly wish him all the best for what comes next in his life!

As another example of Mario's contributions to the IPR, Mario continues to represent the IPR on the international stage as recipient of the High-end Foreign Experts Program Award with Wuhan in the Hubei Province (China). Among other contributions of IPR members are those of Prof. Penlidis as a consultant for four companies in the USA, Canada, and Europe or as program/award evaluator for the Universities of Aalto in Finland and Lisbon in Portugal, NSERC, and the Indian National Academy of Engineering.

The IPR members also continue to distinguish themselves for their contributions to the publication of important and novel achievements in polymer research through their editorial responsibilities. Profs. Penlidis and Vivaldo Lima are both serving on the editorial board of J. Macromol. Sci.- Pure Appl. Chem. and Processes. Prof. Penlidis serves also on the editorial board of Appl. Chem. Polymer-Plastics Techn. and Eng. and Macromol. React. Eng. Prof. Feng is an editorial board member of J. Membrane Sci., Sep. Purif. Technol., J. Eng. Sci. (Pakistan), J. Membrane Sci. Res., and J. Technol. (Malaysia). Prof. Yuning Li serves as an editorial board member of Intl. J. Nano Stud. Technol., Electronics, AIMS Env. Sci., Adv. Nanopart. Prof. Tam is an associate editor for ACS Sustain. Chem. Eng. Prof. Tzoganakis serves on the editorial board of Adv. Polym. Technol. Prof. Zhao became a member of the Editorial Board of Nanomanufacturing and is an associate editor of Frontiers in Chemistry. Prof. Jean Duhamel is an editorial board member with Polymers and a member of the editorial advisory board of Macromolecules and Langmuir.

Before closing this editorial, I look forward to seeing you at the next and 44th IPR Symposium on May 4th, 2022. Our two keynote presentations will be delivered by Prof. John Dutcher from the University of Guelph and co-founder of Mirexus Biotechnologies Inc. and by Dr. Adam Pollit from PolyAnalytik based in London (Ontario), which specializes in gel permeation chromatography. We certainly look forward to your attendance at the IPR Symposium which represents the cornerstone of the IPR activities for promoting the most exciting polymer research!

2. ANNUAL IPR SYMPOSIUM

The 43rd Annual IPR Symposium will be held May 4th, 2022. A schedule and registration forms will be circulated electronically.

Many thanks to all who participated in the 2021 Symposium. IPR received very positive feedback regarding the topics covered. The 2021 program and the list of industrial participants are attached (Appendix 1).

3. IPR INDUSTRIAL MEMBERS

An up-to-date list of our current industrial members is attached (Appendix 2).

4. IPR PREPRINTS

During 2021, the IPR office sent out 17 preprints to our members (Appendix 3).

5. RESEARCH PROGRAMS

We have more than 90 research personnel (excluding faculty) involved in polymer research at the University of Waterloo. Industrial members may find it interesting to keep up to date with the various research projects that are underway.

6. RECENTLY GRADUATED STUDENTS

J. Duhamel

PhD	Chem	Casier, R.	The Structure and Internal Dynamics of Polypeptides Probed with Pyrene Excimer Fluorescence
MSc	Chem	Liu, D.	Synthesis and Characterization of Furan-Based Non-Ionic Surfactants (FBNIOS)
PhD	Chem	Thoma, J.	Characterizing Polymers with Complex Architectures Using Pyrene Excimer Fluorescence
PhD	Chem	Kim, D.	Characterization of the Conformation and Internal Backbone Dynamics of α -Polyglucans by Pyrene Excimer Fluorescence

X. Feng

PhD	ChE	Cao, X.	Separation of phenol and aniline from water using poly(ether-block-amide) membranes
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Y. Li

PhD	ChE	Ngai, J.	Amide-based Donor-acceptor Polymers for Sensor Applications
MASc	ChE	Kumar, P.	On the Influence of Dielectric Constant and Processing Conditions in Organic Solar Cells)
MASC	ChE	Yin, Z.	Wide-bandgap Donor Polymers Based on Thiophene-Vinyl-Thiophene Ester (TVT-Ester) or Thiophene-Alkyloxime (TO) Units in Organic Solar Cells
MASc	ChE	Jiang, Y.	Wide Bandgap Conjugated Polymer Donors based on Alkyloxime Substituted Thiophene for Organic Solar Cells

T. Mekonnen

MASc	ChE	Trinh, B.	Enhanced Barrier Properties of Renewable Multi-phase Polymer Coatings and Films
MASc	ChE	Seto, C.	Lignin derived nano-biocarbon: its deposition on polyurethane foam for wastewater dye adsorption and as a filler for composite applications

A. Penlidis

MASc	ChE	Mavani, B.	Polymeric materials for detection of warfare agents
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D. Schipper

PhD	CHEM	Mirabal, R.	Part 1: Towards the Synthesis of Pyrene Zigzag Cyclacenes, Part 2: New Methods for the Synthesis of Conjugated Polymers
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M. Tam

PhD	ChE	Tang, C.	Functionalized Cellulose Nanomaterials for Integrated Environmental Management
PhD	ChE	Alharthi, S.	Cationic Cellulose Nanocrystals for the Flocculation of Mature Fine Oil Sands Tailings
PhD	ChE	Baek, J.	Modified Cellulose Nanocrystals (CNC) for Functional Foods
MASc	ChE	Shahid, I.	Nanocellulose-based systems for the removal of perfluoroalkyl compounds from water
MASc	ChE	Haji, F.	Functionalized Cellulose Nanocrystals with Enhanced Mucoadhesive Properties

C. Tzoganakis

MASc ChE Seto, C. Lignin derived nano-biocarbon: its deposition on polyurethane foam for wastewater dye adsorption and as a filler for composite applications

B. Zhao

MASc ChE Liu, M. Antimicrobial activity of polyethylenimine/polyurethane (PEI/PU) colloidal films
MASc ChE Sun, M. Micro-Additive Manufacturing of Metal-Oxide-Semiconductor Based Gas Sensors for Diabetes Detection via Breath Analysis

7. ACADEMIC MEMBERS OF THE INSTITUTE FOR POLYMER RESEARCH

Professors:

R. Dhib	Chem. Eng.	Ryerson
T.A. Duever	Chem. Eng.	Ryerson
J. Duhamel, Director	Chemistry	Waterloo
X. Feng	Chem. Eng.	Waterloo
J. Forrest	Phys. Astro.	Waterloo
M. Gauthier	Chemistry	Waterloo
Y. Li	Chem. Eng.	Waterloo
N. McManus	Chem. Eng.	Waterloo
T. Mekonnen	Chem. Eng.	Waterloo
A. Penlidis	Chem. Eng.	Waterloo
D. Schipper	Chemistry	Waterloo
L. Simon	Chem. Eng.	Waterloo
M. Tam	Chem. Eng.	Waterloo
C. Tzoganakis	Chem. Eng.	Waterloo
E. Vivaldo-Lima	Chem. Eng.	UNAM, Mexico
X. Wang	Chemistry	Waterloo
B. Zhao	Chem. Eng.	Waterloo

For a brief description of research interests and projects, along with contact information, please visit the following web link: www.uwaterloo.ca/institute-polymer-research/

8. MEMBER COMPANIES—2021

Currently, there are **7 member companies**: (refer also Appendix 3)

Afton

Compuplast Canada Inc.

Lanxess Inc.

Mondelez Inc.

Synothomer Inc.

PolyVision, The Netherlands

Princeton Polymer Consultants, USA

9. STUDENT AWARDS

X. Feng

Xiaotong Cao, 2021 IPR Award

J. Duhamel

Damin Kim: 2021 IPR Award

Hunter Little: 2021 Ontario Graduate Scholarship

Y. Li

Scott Flynn, Canada Graduate Scholarships – Master's program – NSERC (May 2021-April 2022)

B. Zhao

A-Reum Kim was awarded the WIN Nanofellowship

Dr. Penxiang Si was awarded the Chemical Engineering Medal for Proficiency in Research - Park Reilly Medal.

10. FACULTY AWARDS

E. Vivaldo-Lima

Prof. Vivaldo-Lima renewed his membership to UNAM's Evaluation Performance System (PRIDE), for five additional years (August 2021-July 2026), obtaining again the maximum level (Level D).

Boxin Zhao

Professor Boxin Zhao awarded a University of Waterloo Endowed Chair in Nanotechnology

J. Duhamel

2021 Award of the Macromolecular Science and Engineering Division (MSED) of the Chemical Institute of Canada.

T. Mekonnen

2021 (Outstanding performance Award – Faculty of Engineering)

11. FULL REFEREED JOURNAL PAPERS

J. Duhamel

Casier, R.; Duhamel, J. Blob-Based Predictions of Protein Folding Times from the Amino Acid Dependent Conformation of Polypeptides in Solution. *Macromolecules* 2021, 54, 919-929.

Ba Salem, A.; Duhamel, J. Determination of the Aggregation Number of Pyrene-Labeled Gemini Surfactant Micelles By Pyrene Fluorescence Quenching Measurements. *Langmuir* 2021, 37, 6069-6079.

Yuan, W.; Casier, R. Duhamel, J. Unfolding of Helical Poly(L-Glutamic Acid) in N,N-Dimethylformamide Probed by Pyrene Excimer Fluorescence (PEF). *Polymers* 2021, 13, 1690. (Editor's Choice Article)

Casier, R.; Duhamel, J. The Effect of Glycine on the Local Conformation and Internal Backbone Dynamics of Polypeptides. *Macromolecules* 2021, 54, 8904-8912.

Ba Salem, A.; Duhamel, J. Synthesis and Characterization of a Pyrene-Labeled Gemini Surfactant Sensitive to the Polarity of its Environment. *Langmuir* 2021, 37, 13824-13837.

X. Feng

Z. Li, K. Hu, X. Feng (2021), "Concentration of potassium acetate solutions via sweeping gas pervaporation using TFC membranes comprising of a PDA sublayer and PEI/PAA bilayers," *Separation and Purification Technology*, 277, 119429.

H. Li, S. Lin, X. Feng, Q. Pan (2021), "Preparation of superhydrophobic and superoleophilic polyurethane foam for oil spill cleanup," *Journal of Macromolecular Science, Part A - Pure and Applied Chemistry*, 58, 758-768.

X. Cao, K. Wang, X. Feng (2021), "Removal of phenolic contaminants from water by pervaporation," *Journal of Membrane Science*, 623, 119043.

Z. He, K.L. Goh, X. Feng, K. Wang (2021), "Measuring the permeabilities of binary gas mixtures with a novel time-lag technique," *Canadian Journal of Chemical Engineering*, 99, 2713-2722.

X. Cao, K. Wang, X. Feng (2021), "Perstraction of phenolic compounds via nonporous PEBA membranes," *Separation and Purification Technology*, 257, 117928.

Y. Wang, T. Xiao, Z. Zhang, X. Feng, "Extraction and concentration of glutathione from yeast by membranes," *Canadian Journal of Chemical Engineering*, accepted Jan 8, 2021

C. Du, J.D. Du, X. Zhao, F. Cheng, M.E.A. Ali, X. Feng (2021), "Treatment of brackish water RO brine via bipolar membrane electrodialysis," *Industrial & Engineering Chemistry Research*, 60, 3115-3129.

J. Liu, J. Liang, X. Feng, W. Cui, H. Deng, Z. Ji, Y. Zhao, X. Guo, J. Yuan (2021), "Effects of inorganic ions on the transfer of weak organic acids and their salts in electrodialysis process," *Journal of Membrane Science*, 624, 119109.

C. Wang, Y. Chen, X. Hu, X. Feng (2021), "In situ synthesis of PA/PVDF composite hollow fiber membranes with an outer selective structure for efficient fractionation of low-molecular-weight dyes-salts," *Desalination*, 503, 114957.

W.J. Lau, X. Feng (2021), "60 years of the Loeb-Sourirajan membrane: From fundamental research to industrial application," *Editorial, Chemical Engineering Research and Design*, 168, 297.

- X. Zhang, M. Yan, X. Feng, X. Wang, W. Huang (2021), "Ethylene/propylene separation using mixed matrix membranes of poly(ether block amide)/nano-zeolite (NaY or NaA)," *Korean Journal of Chemical Engineering*, 38, 576–586.
- Y. Ma, W. Zhang, H. Li, C. Zhang, H. Pan, Y. Zhang, X. Feng, K. Tang, J. Meng (2021), "A microporous polymer TFC membrane with 2-D MOF nanosheets gutter layer for efficient H₂ separation," *Separation and Purification Technology*, 261, 118283.
- X. He, S. Lin, X. Feng, Q. Pan (2021), "Synthesis and modification of polyurethane foam doped with multi-walled carbon nanotubes for cleaning up spilled oil from water," *Journal of Polymers and the Environment*, 29, 1271–1286.
- Y. Huang, M.U. Farooq, P. Kundu, S. Hazarika, X. Feng (2021), "Use of fibroin polypeptide from silk processing waste as an effective biosorbent for heavy metal removal," *Canadian Journal of Chemical Engineering*, 99, S605–S615. (Selected by Editor for inclusion in Virtual Issue "Sustainability in Chemical Engineering").
- C. Du, J.R. Du, X. Feng, J. Wang (2021), "Green extraction of perilla volatile organic compounds by pervaporation," *Separation and Purification Technology*, 261, 118281. surface flow," *Canadian Journal of Chemical Engineering*, 98, 775-784.

Y. Li

- Sun, B.; Li, Y. Ubiquitous Clean and Sustainable Energy-Driven Self-Rechargeable Batteries Realized by and Used in Organic Electronics. *J. Mater. Chem. C* 2022, 10 (2), 388–412. <https://doi.org/10.1039/D1TC04122C>.
- Polena, J.; Afzal, D.; Ngai, J. H. L.; Li, Y. Temperature Sensors Based on Organic Field-Effect Transistors. *Chemosensors* 2021, 10 (1), 12. <https://doi.org/10.3390/chemosensors10010012>.
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Li, W.; Abd-Ellah, M.; Liu, H.; Li, X.; Yin, Z.; Kumar, P.; Wang, J.; Li, Y. Novel Wide Bandgap Benzodithiophene-Based Polymer Donors with Electron-Withdrawing Indolin-2-One Side Chains for Efficient Organic Solar Cells with High Open Circuit Voltage. *Dyes and Pigments* 2021, 109876. <https://doi.org/10.1016/j.dyepig.2021.109876>
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- Gao, X.; Guo, C.; Ma, Z.; Xi, G.; Meng, Y.; Li, Y. Boosting Li–S Battery Performance Using an in-Cell Electropolymerized Conductive Polymer. *Mater. Adv.* 2021, 2 (3), 974–984. <https://doi.org/10.1039/D0MA00797H>.
- Ngai, J. H. L.; Gao, X.; Kumar, P.; Polena, J.; Li, Y. A Highly Stable Diketopyrrolopyrrole (DPP) Polymer for Chemiresistive Sensors. *Adv. Electron. Mater.* 2021, 7 (3), 2000935. <https://doi.org/10.1002/aelm.202000935>.
- He, K.; Kumar, P.; Yuan, Y.; Li, Y. Wide Bandgap Polymer Donors for High Efficiency Non-Fullerene Acceptor Based Organic Solar Cells. *Mater. Adv.* 2021, 2 (1), 115–145. <https://doi.org/10.1039/D0MA00790K>.