INTERNATIONAL POLYMER AND COLLOIDS GROUP

SPRING 2026 NEWSLETTER

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IPCG 2027
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UPCOMING SHORT COURSES & CONFERENCES

Polymeric Materials for Additive Manufacturing Workshop

Centro Joxe Mari Korta, Donostia, San Sebastian (Spain)
May 25-28, 2026

Dr. Haritz Sardon, Course Director
Associate Professor, POLYMAT, University of the Basque Country

57th Annual Short Course Advances in Emulsion Polymerization and Latex Technology

Lehigh University, Bethlehem, PA, USA
June 1-5, 2026

Dr. Mohamed S. El-Aasser, Course Director Professor,
Department of Chemical & Biomolecular Engineering
Lehigh University
Ms. Debra Nyby, Course Coordinator
Department of Chemical & Biomolecular Engineering
Lehigh University

49th Annual Short Course Advances in Emulsion Polymerization and Latex Technology

Davos, Switzerland
August 10-14, 2026

Dr. Mohamed S. El-Aasser, Course Director
Professor, Department of Chemical & Biomolecular Engineering Lehigh University
Dr. F. Joseph Schork, Course Director
Professor Emeritus, School of Chemical and Biomolecular Engineering
Georgia Institute of Technology

Emulsion Polymerization Processes

Donostia, San Sebastian (Spain)
September 7-11, 2026

Contact Person: Ms. Inés Plaza (POLYMAT, UPV/EHU)
Organizer: **POLYMAT – University of the Basque Country (UPV/EHU)**

Obituary
Anton Leendert German

Anton Leendert (Ton) German was born on the first of February 1939 in Alphen aan den Rijn. He obtained his HBS-B diploma at the Lyceum in Steenwijk and then studied chemical technology at the Eindhoven University of Technology where he obtained his masters diploma Cum Laude in 1964. He was awarded the Unilever Chemistry award in that same year. In 1970, he completed his PhD with the dissertation" The Copolymerization of Ethylene and Vinylacetate at low Pressure; Determination of the Kinetics by Sequential Sampling" under the supervision of Prof. Dr. D. Heikens. From 1964 onward, he continued his career at the TU/e, where he was appointed as lector in 1974, later followed by full professor. From 1971 to 1972 he served as associate professor of Chemistry at the Baylor College of Medicine of the Texas Medical Centre. It was there that his interest in the United States was raised, leading to many future trips to the US.

In 1987, Ton German founded the Foundation Emulsion Polymerization (SEP) together with Jos van der Loos. As one of the first initiatives in its kind, this successful multi-sponsored industrial liaison program brought together companies active in the field of emulsion polymerization and facilitated research in that field through PhD projects. In 2000 SEP consisted of more than 20 companies like BASF, AKZO-NOBEL, Dupont, Rohm and Haas and ICI. The program also facilitated many PhD projects.

Ton German was a key figure in developing knowledge in the area of radical polymerization, copolymerization, emulsion polymerization and on-line sampling and he started the work on vesicle polymerization. In total Ton German acted as 1st promotor for almost 40 PhD students and guided many more bachelor and master students. One of his strengths was disseminating his knowledge in a very clear way, not only at the many scientific conferences he attended, but also in his teaching, inspiring many of his staff and students. He organized several conferences, like the Irsee, Germany 1992 Gordon Research Conference on Polymer Colloids and in June 2001, together with Michael Buback, the SML conference in "Free Radical Polymerization, Kinetics and Mechanism" in Il Ciocco, Barga, Italy. In 2000 he was part of the First European Graduate School on "Microstructural Control in Free Radical Polymerization", TU/e together with the University of Amsterdam, the Technical University Clausthal and The University of Göttingen.

Ton German was very active in the IPCG community, attending many of the Gordon Conferences from the nineteen eighties till 2000. He retired in 2001 and happily spending his retirement with traveling, his children and grandchildren.

Ton German died on the 20th of January 2026.

Ton German is survived by his partner Gerda, his two children and four grandchildren.

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Contribution: Prof. Steven P. Armes

List of Recent Publications

1. "Supra-particle formation by evaporation of aerosol droplets containing binary mixtures of colloidal particles: spherical vs. buckled morphologies", L. K. Mahato, S. Varlas, B. E. A. Miles, D. H. H. Chan, D. A. Hardy, J.-C. Eloi, R. L Harniman, R. E. H. Miles, S. P. Armes* and J. P. Reid*, *J. Colloid Interface Sci*., 682, 251-262 (2025).
2. "A highly anisotropic and hydrolytically degradable Pickering emulsifier for oil-in-water emulsions", J. J. S. Tyler, M. A. H. Farmer, O. O. Mykhaylyk, M. J. Orchard, O. M. Musa and S. P. Armes*, *Langmuir*, 41, 16896-16904 (2025).
3. "pH-responsive diblock copolymer vesicles via polymerization-induced self-assembly in aqueous media: synthesis, loading, and potential biological applications", J. Edmans, A. El-Howati, K. M. Slowik, H. E. Colley*, C. Murdoch, P. V. Hatton and S. P. Armes*, *ACS Applied Materials & Interfaces*, 17, 35140-35154 (2025).
4. "Degradable diblock copolymer vesicles via radical ring-opening polymerization-induced self-assembly in aqueous media", P. G. Georgiou, T. J. Neal, M. A. Newell, K. S. Hepburn, J. J. S. Tyler, M. A. H. Farmer, P. Chohan, P. J. Roth, J. Nicolas and S. P. Armes*, *J. Am. Chem. Soc*., 147, 19817-19828 (2025).
5. "Effect of added salt and hydrophobic comonomer on the synthesis and adsorption behavior of cationic sterically-stabilized nanoparticles", H. Buksa, A. Xie, D. H. H. Chan, O. Norvilaite, G. Sanderson, R. M. Corrigan and S. P. Armes*, Langmuir, 41, 20929-20941 (2025).
6. "Sustainable silica microcapsules", O. Norvilaite, M. J. Rymaruk, C. Lindsay, P. Taylor, and S. P. Armes*, *Green Chemistry*, 27, 12421-12437 (2025).
7. "New synthetic mimics for heteroatom polycyclic aromatic hydrocarbon-based cosmic dust", D. H. H. Chan, E. E. Brotherton, S. P. Armes*, J. L. Wills, J. D. Tandy, M. J. Burchell, P. J. Wozniakiewicz and L. S. Alesbrook, *Langmuir*, 41, 28995–29008 (2025).
8. "Time-resolved SAXS studies during the synthesis of hydrolytically degradable poly(ε-caprolactone)-poly(N,N′-dimethylacrylamide) diblock copolymer nanoparticles in aqueous media", M. A. H. Farmer, O. O. Mykhaylyk, O. Shebanova, O. M. Musa and S. P. Armes*, *Angewandte Chem.*, 65, e24000 (2026).
9."Preparation of microcapsules using a poly(2-(dimethylamino)ethyl methacrylate)-b-poly (benzyl methacrylate) diblock copolymer emulsifier", V. Kallebäck*, C. György, G. Eriksson, S. P. Armes, M. Andersson-Trojer and L. Evenäs, *Langmuir*, 42, 392-399 (2026).
10."Depolymerization-induced morphological transformation (DIMT)", N. D. Watuthanthrige, V. Lohmann, V. Lutz-Bueno, N. P. Truong, S. P. Armes*, and A. Anastasaki*, *J. Am. Chem. Soc.*, in the press (2026).

List of Submitted Manuscripts

11."Impact ionization properties of polypyrrole nanoparticles", R. Mikula, Z. Sternovsky, S. P. Armes, E. Ayari, D. H. H. Chan, J. Bouwman, M. Horanyi, S. Kempf, J. K. Hillier, N. Khawaja and F. Postberg, *ACS Earth and Space Chemistry*, submitted for publication (2026).
12. "Synthetic mimics for nitrogen-based polycyclic aromatic hydrocarbon cosmic dust: preparation and preliminary impact ionization mass spectrometry studies", M. Zeng, D. H. H.

Chan, S. P. Armes*, R. Mikula, J. Fontanese and Z. Sternovsky, *J. Am. Chem. Soc*., submitted for publication (2026).
13. "Core-block engineering enables control of ice recrystallization inhibition in polymer nanoparticles", P. G. Georgiou, C. B. Oral, H. F. Mack, H. Buksa, C. Bao, C. György, S. P. Armes* and M. I. Gibson*, *Angewandte Chem.*, submitted for publication (2026).
14. "Non-cytotoxic binary mixtures of cationic nanoparticles and polymer chains kill polymicrobial communities", H. Buksa, M. Trebell, N. Holt, W. M. Durham, R. Suzuki, M. Tanaka, R. M. Corrigan and S. P. Armes*, *ACS Nano*, submitted for publication (2026).
15. "Artificial biominerals with self-sorted polymer nanoparticles" W. T. Chen, Z. Fan, P. Liu, X. H. Hu*, Y. H. Yang, Q. Li, M. J. Wang, J. He, W. J. Zhang*, S. P. Armes* and Y. Ning*, *Nature Materials*, submitted for publication (2026).
16. "Synthesis of anisotropic poly(δ-valerolactone)-poly(N,N'-dimethylacrylamide) particles in concentrated aqueous media via reverse sequence polymerization-induced self-assembly", M. A. H. Farmer, O. O. Mykhaylyk, O. M. Musa and S. P. Armes*, *Chemical Science*, submitted for publication (2026).

Contribution: Prof. Syuji FUJII

List of Recent Publications

1. T. Funatsu, H. Takanohashi, S. Fujii*, “Mechanical properties of waterborne polyurethane latex film formed from acrylic and blocked polyisocyanate particles” ***Journal of Applied Polymer Science*** (2026) in press
2. T. Funatsu, H. Takanohashi, S. Fujii*, “Waterborne crosslinked polyurethane latex film formed from acrylic and blocked polyisocyanate particles” ***Progress in Organic Coatings*** *208*, 109534 (2025) DOI: 10.1016/j.porgcoat.2025.109534
3. J. Yamaguchi, Y. Tsumura, M. Hanasaki, S. Arima, T. Matsuura, S. Fujii*, “Edible Pickering emulsion stabilized with silkworm particles” ***ACS Food Science & Technology*** (2025) DOI: 10.1021/acsfoodscitech.5c00407
4. B. T. Lobel*, S. Sugiyama, O. Owens, O. Cayre*, S. Fujii*, “Dry liquid to Pickering-type emulsion: Fabrication of non-spherical environmentally friendly microcapsules” ***Chemical Communications*** *61*, 7628-7631 (2025) DOI: 10.1039/D5CC00209E
5. U. Sultan, C. Kotulla, K. Kefle, S. Fujii*, N. Vogel*, “Rough and Tough: How particle surface roughness affects liquid marble formation and stability” ***Advanced Science*** *12(25)*, 2501378 (2025) DOI: 10.1002/advs.202501378
6. K. Kuroiwa, K. Takeuchi, T. Hirai, Y. Nakamura, Y. Oaki*, S. Fujii*, “Janus particles synthesized via vapor-phase coupling polymerization protocol” ***Langmuir*** *41(8)*, 5439-5448 (2025) DOI: 10.1021/acs.langmuir.4c05061
7. Y. Atsuta, K. Takeuchi, T. Sakuma, K. Mitamura, S. Watase, T. Hirai, Y. Nakamura, Y. Oaki*, S. Fujii*, “Synthesis of polypyrrole and its derivative nanoparticles via surfactant-free coupling polymerization protocol” ***Polymer Journal*** *57*, 723-735 (2025) DOI: 10.1038/s41428-025-01026-8

Titles and abstracts of unpublished papers

Title. From Passive to Active: A Paradigm Shift in Coatings Formulation and Film Formation

Abstract: Coatings are widely used in protective and functional applications but are fundamentally limited by the passive nature of their formulation ingredients. This leads to a critical lack of control over the spatial distribution of ingredients and prevents the optimization of key functional properties.
Addressing this challenge, we propose a paradigm shift towards active coating formulations. We introduce active Janus particles in coatings formulations and demonstrate how they overcome sedimentation and chemical gradients to accumulate at both top and bottom coating interfaces. To achieve this programmable microstructure, we balance the timescales of active particle fuel depletion and evaporation-induced assembly. We find that Janus particles at the top coating surface have an orientational bias, with the sub-equatorial orientation being the most common. This work lays the foundation for future studies developing functional coatings with programmable microstructures
and dual functionalities enabled by orientation-biased active particles.

Published articles

Effect of surface charge and rigidity of liposomes on their interaction with gold nanoparticles. Ghazaleh Mazaheri Tehrani, Constantina Sofroniou, Malika Singh, Najet Mahmoudi, Steven Huband, Owen Davies, Ignacio Martin-Fabiani. Journal of Colloid and Interface Science 699 (2025) 138267.

Hollow polymer-silica particles as an alternative to TiO2 opacifiers. Constantina Sofroniou, Sarah Chong, Timothy J. Murdoch, Edgar Espinosa Rodriguez, Franck D'Agosto, Muriel Lansalot, Stefano Sacanna, Ignacio Martín-Fabiani. Progress in Organic Coatings 211 (2026) 109817.

Tuning photophysical properties of semiconducting polymer nanoparticles for improved photocatalytic activity. Jose Sena-Fernández, Esther Rebollar, Aitana Hurtado-Mendoza, Timothy J. Murdoch, Juan Francisco Vega, Ignacio Martín-Fabiani, Tiberio A. Ezquerra and Aurora Nogales. Nanoscale, 2025, 17, 14904–14912.

Harnessing Particle Size Segregation to Tune Molecular Additive Distribution in Coatings *(Published as part of the special issue "Celebrating the Legacy of Prof. Jose M. Asua: Emulsion Polymerization and Polymer Reaction Engineering").* Huyen Le, Timothy J. Murdoch, Aitor Barquero, Radmila Tomovska, and Ignacio Martin-Fabiani. Ind. Eng. Chem. Res. 2026, 65, 1241−1251.

Contribution: Prof. L. Andrew Lyon

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Titles and abstracts of recent published papers

1.Lyon, L. A. in *Micro and Nano Gels: Synthesis, Characterization, Modelling, and Applications* (eds Daisuke Suzuki & Takuma Kureha) pp.15-29 (Wiley-VCH GmbH, 2026).

Summary. This chapter briefly reviews the progress made in the field of microgels towards clinical and commercial translation of microgel-based technologies. Examples of commercial activities are described, along with a perspective on the future potential of nascent technologies not yet commercialized. Given the progress made, an outlook for the future of the field is presented, highlighting the hurdles yet to be overcome and the tremendous opportunities that remain for the field as a whole.

2.Alruwaili, A., Alkhudhari, O. M., Wang, R., Jia, Z., Saunders, J. M., Picheo, E., Toolan, D. T. W., Lyon, L. A. & Saunders, B. R. Assembly of non-close-packed poly(N-isopropylacrylamide) microgels on metal halide perovskite films. *Journal of Colloid and Interface Science* **701**, 138591 (2026). https://doi.org/https://doi.org/10.1016/j.jcis.2025.138591

Abstract. Poly(N-isopropylacryamide) microgels (PNIPAM MGs) are interesting model colloids with remarkable self-ordering properties. Metal halide perovskites (MHPs) are solution processable semiconductors that have attracted great interest for optoelectronics applications. Very few studies have considered complex co-crystallizing systems and their effects on structural order formation. This work examines PNIPAM MG ordering within a MHP matrix and investigates whether these pure PNIPAM MGs could form arrays on the MHP surface, passivate MHP defects and provide structurally colored films and solar cells. Experiments We use a mixed cation MHP (FA0.88MA0.12PbI3) (FA and MA are formamidinium and methylammonium) and investigate the effects of MG size and PNIPAM MG/MHP composite composition on two-dimensional non-closed packed hexagonal array (2D-NCPHA) formation and structural color. SEM and angle-dependent observations of illuminated films are used to assess structural order as well as the colors of light generated within composite films and MHP solar cells. The colors observed were converted to CIE1931 values and the color trends predicted by a simple ray-tracing equation. Findings We show that spontaneous ordering of PNIPAM MGs occurred on the MHP matrix and caused color generation from a relatively thick co-crystallizing MHP matrix. An optimum PNIPAM MG diameter is identified and the mechanisms operative are elucidated. Structurally colored solar cells are also demonstrated and their efficiency improvement is due to PNIPAM passivation of MHP defects. The results of this study indicate that PNIPAM 2D-NCPHA formation is highly tolerant to solution species and would allow, in principle, such phenomena to be achieved in other co-crystallizing matrices.

3.Narbay, E., Caine, A., Pandit, S., Montgomery, G., Harper, M., Cárdenas-Vásquez, E. D., Hamilton, H., Hicks, M., Mattar, D., Choy, K., Bisoffi, M. & Lyon, L. A. Dynamic, Reconfigurable, and Hierarchical Biosynthetic Composites via Collagen Self-Assembly within Highly Crowded Microgel Pastes. *Adv. Mater.* **n/a**, e15114 (2025).
https://doi.org/https://doi.org/10.1002/adma.202515114

Abstract. The fabrication of a new class of biomimetic biomaterials is reported using nanostructured microgel pastes formed from ‘overpacked’ assemblies of ultrasoft poly(N-isopropyl acrylamide-co-acrylic acid) microgels and their composites with collagen. Despite the solid-like nature of microgel pastes, collagen fibrillogenesis is robust and rapid, with a 3D collagen network forming throughout the paste volume. Structural organization within the composite is interrogated via a suite of microscopy methods, while rheological characterization provides insight into the static and dynamic mechanical properties of the materials. Long-range fibrillogenesis is enabled by local crowding, dynamics, and spatial reconfigurability of pastes at the colloidal length-scale, and by liquid-liquid phase separation during fibril formation, features that mimic the dynamic reorganization of natural extracellular matrix. In vitro 3D cell culture studies illustrate that the paste is non-toxic, permeable to nutrients, and permissive to cell invasion, while collagen fibers present sites for cell attachment and spreading. Together, these results suggest the platform's potential in the development of tissue scaffolds that mimic crowded and dynamic biological tissues. These materials address the need for new approaches to biomaterials that offer dynamic, bio-integrative environments for tissue healing and regenerative medicine via synthetic and spatial control from the polymer to the macroscopic length scales.

4.Nellenbach, K., Mihalko, E., Nandi, S., Koch, D. W., Shetty, J., Moretti, L., Sollinger, J., Moiseiwitsch, N., Sheridan, A., Pandit, S., Hoffman, M., Schnabel, L. V., Lyon, L. A., Barker, T. H. & Brown, A. C. Ultrasoft platelet-like particles stop bleeding in rodent and porcine models of trauma. *Science Translational Medicine* **16**, eadi4490 (2024). https://doi.org/doi:10.1126/scitranslmed.adi4490

Abstract. Uncontrolled bleeding after trauma represents a substantial clinical problem. The current standard of care to treat bleeding after trauma is transfusion of blood products including platelets; however, donated platelets have a short shelf life, are in limited supply, and carry immunogenicity and contamination risks. Consequently, there is a critical need to develop hemostatic platelet alternatives. To this end, we developed synthetic platelet-like particles (PLPs), formulated by functionalizing highly deformable microgel particles composed of ultralow cross-linked poly (*N*-isopropylacrylamide) with fibrin-binding ligands. The fibrin-binding ligand was designed to target to wound sites, and the cross-linking of fibrin polymers was designed to enhance clot formation. The ultralow cross-linking of the microgels allows the particles to undergo large shape changes that mimic platelet shape change after activation; when coupled to fibrin-binding ligands, this shape change facilitates clot retraction, which in turn can enhance clot stability and contribute to healing. Given these features, we hypothesized that synthetic PLPs could enhance clotting in trauma models and promote healing after clotting. We first assessed PLP activity in vitro and found that PLPs selectively bound fibrin and enhanced clot formation. In murine and porcine models of traumatic injury, PLPs reduced bleeding and facilitated healing of injured tissue in both prophylactic and immediate treatment settings. We determined through biodistribution experiments that PLPs were renally cleared, possibly enabled by ultrasoft particle properties. The performance of synthetic PLPs in the preclinical studies shown here supports future translational investigation of these hemostatic therapeutics in a trauma setting.

Contribution: Prof. Alex van Herk

Contribution of Em. Prof. Alex van Herk
Eindhoven University of Technology, The Netherlands
and
Nanyang Technical University, Singapore
Email: A.M.v.Herk@tue.nl

Free software to calculate reactivity ratios according to the IUPAC recommended method:

1 Software package Contour issue 2.4.0 A.M. van Herk, accessed 29/10/2024 Contour 2.4.0
2 Code in Python for the Visualization of Sum of Squares Space (VSSS) method applied on f_0-X-F data, accessed 29/10/2024 Pythoncode
3 Code in Excel (via VB) for the VSSS method applied on f_0-X-F data, accessed 29/10/2024 Excel application

Paper to be submitted to Macromolecules:

Systematics of Copolymerization Reactivity Ratios of (Meth)acrylic Acid and MPEG Macromonomers for the controlled synthesis of PCE Superplasticizers

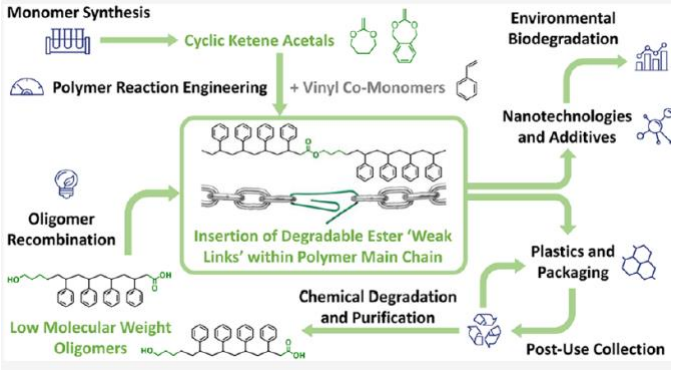
Polycarboxylate ether superplasticizers (PCEs) are typically produced by aqueous free-radical copolymerization of an acid monomer (methacrylic acid (MAA), or acrylic acid (AA)) with a macromonomer (poly(ethylene glycol) methyl ether methacrylate (MPEG)). The composition drift during copolymerization broadens the chemical composition distributions. Reliable reactivity ratios are essential for building direct property- structure relationships for PCEs, as well as controlling the copolymerization to obtain more homogeneous PCEs. Here, accurate reactivity ratios were determined for MAA/AA–MPEG systems under unadjusted acidic conditions at 70 °C by systematically varying (i) acid identity, (ii) MPEG molecular weight, (iii) the monomer feed fraction and (iv) solid content (5 and 20 wt%). Reactivity ratios were obtained from f_0-X-F data measured by quantitative ^{1}H NMR and analyzed with the IUPAC workflow implemented in Contour. Reactivity ratio analysis shows that, initial solid content has little influence on the reactivity ratios at low pH, whereas acid identity and MPEG molecular weight govern variations in reactivity ratios and composition drift. A clear correlation between MPEG molecular weight and reactivity ratios was obtained; raising MPEG molecular weight consistently reduced the apparent homopropagation, thus decreasing the reactivity ratio. These accurate parameters enable predictive drift simulations and practical design rules (e.g., optimal monomer addition profiles) for controlling PCE homogeneity, backbone composition and side chain spacing.

Recently published papers:

In Search of a Weak Link: Toward Biodegradability and Circular Economies Using Cyclic Ketene Acetals

Published as part of Industrial & Engineering Chemistry Research special issue "Celebrating the Legacy of Prof. Jose M. Asua: Emulsion Polymerization and Polymer Reaction Engineering".
Alexander W. Jackson, Alexander M. van Herk, and Praveen Thoniyot**

Industrial & Engineering Chemistry Research **2026**, 65, 1, 34-46 **(Perspective)**



Experimental methods and data evaluation procedures for the determination of radical copolymerization reactivity ratios from composition data (IUPAC Recommendations 2025)
Anton A. A. Autzen, Sabine Beuermann, Marco Drache, Christopher M. Fellows, Simon Harrisson, Alex M. Van Herk, Robin A. Hutchinson, Atsushi Kajiwara, Daniel J. Keddie, Bert Klumperman and Gregory T. Russell*
Pure & Applied Chemistry, vol. 97, no. 11, **2025**, 1455-1463.

An Improved Iterative Method to Obtain Optimal Monomer Addition Profiles in Copolymerizations
*Wendy Rusli and Alexander M. van Herk**
Macromol. React. Eng. **2025**, 2400055

Monomer Transport by Collisions in (Mini) Emulsion Polymerization, a Personal Perspective
Alexander M. van Herk
Macromol. React. Eng. **2024**, 2400013

Backbone-Degradable Acrylate Latex: Toward Overcoming Hydrolysis Limitations of Cyclic Ketene Acetal Monomers
*Srinivasa Reddy Mothe, Wenguang Zhao, Alexander M. van Herk, and Praveen Thoniyot**
Macromolecules **2024**, 57, 2937−2949

Contribution: Prof. Alex Routh

Recently completed work

Robert Groves, Kota Hatakeyama & Alexander F. Routh, *Mechanisms of Electrolyte (Coagulant) Dipping for thin nitrile gloves*.

Two mechanisms for film deposition during the electrolyte dipping process are examined. The conventional, widely accepted, mechanism proposes that electrolyte on a former, immersed in latex compound for a controlled dwell time, diffuses into the compound and a wet gel coagulates on the former where the electrolyte concentration is above the critical coagulation value. An alternative, mechanism proposes that deposition occurs via particle movement towards the former driven by diffusiophoresis.

The two mechanisms are examined via dipping nitrile latex compound and various mono and divalent cation electrolytes. The similarity of the total solids content (TSC) of the deposit on the former to that of the compound, the coagulated nature of the deposit and the success, at short dwell times, of a diffusion-coagulation model show that diffusion and coagulation operates exclusively for the divalent cations.

For the monovalent cation electrolytes, this mechanism is also dominant, but the TSC of the deposits suggests that diffusiophoresis also plays a small part in the deposition process.

A model for the two mechanisms acting together was devised and applied to deposition given by three monovalent electrolytes. This gave deposit TSCs that agreed with the diffusiophoretic prediction and was independent of dwell time. Quantitatively, the calculated amounts of deposit agreed reasonably well with experiment. The model therefore provides some support for diffusiophoresis affecting deposition for monovalent electrolytes.

The reason(s) for the different diffusiophoresis behaviour of the monovalent and divalent electrolytes is suggested to be due to the much lower critical coagulation concentration for the divalent cations.

Recently published papers

Benjamin T. Lobel, Daniele Baiocco, Mohammed Al-Sharabi, Alexander F. Routh, Zhibing Zhang, Olivier J. Cayre, *Non-spherical particle stabilised emulsions formed through destabilisation and arrested coalescence*, Langmuir 41(1): 550-562 2025.

Mohammed Al-Sharabi, Benjamin T. Lobel, Daniele Baiocco, Olivier J. Cayre, Zhibing Zhang and Alexander F. Routh, *Multicore Silica Microcapsules Containing α-Tocopherol for Potential Consumer Product Applications,* Materials Advances, 6:1468 – 1477 2025.

Dan Baiocco, Benjamin Lobel, Mohammed Al-Sharabi, Olivier Cayre, Alexander Routh and Zhibing Zhang, *Organic-Inorganic Multi-layer Microcarriers with Superior Mechanical*

Properties for Potential Active Delivery in Fast-Moving Consumer Goods, Industrial & Engineering Chemistry Research 64 (9) : 4917-4931 2025.

Mingchuan Zheng, Patrick R. L. Welche, Silvana S. S. Cardoso, Herbert E. Huppert, Julyan H. E. Cartwright and Alexander F. Routh, *Diffusion-controlled growth of a planar chemical garden wall before osmotic fracture*, Philosophical Transactions A 383:20240266 2025.

Maria Zacharopoulou, Neeleema Seetaloo, James Ross, Amberley S. D. Stephens, Giuliana Fusco, Thomas McCoy, Wenyue Dai, Ioanna Mela, Ana Fernandez Villegas, Alexander F. Routh, Alfonso De Simone, Jonathan J. Phillips, Gabriele S. Kaminski Schierle, *Local ionic conditions modulate the aggregation propensity and define the structural polymorphism of alpha-synuclein,* JACS 147(16):13131-13145 2025.

Mingchuan Zheng, Emmanuelle Dumont, Romero D. Featherstone, Nicholas Mackay, Herbert E. Huppert, Julyan H. E. Cartwright and Alexander F. Routh, *Differing growth dynamics in seed-grown planar vertical chemical gardens*, accepted by Soft Matter

Contribution: Dr. Daniel Horak

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Recent publications

Surface-engineered core-shell upconversion nanoparticles for effective hypericin delivery and multimodal imaging. Vasylyshyn T., Huntošová V., Olejárová S., Slabý C., Jurašeková Z., Bánó G., Kubacková J., Šlouf M., Patsula V., Shapoval O., Horák D., *Nanoscale* 17, 5838-5857 (2025).

Abstract. Early diagnosis and treatment of cancer is rapidly advancing thanks to the development of nanotechnology. Here, upconversion nanoparticles (UCNPs) are particularly promising as they are finding a wide range of applications in drug delivery and tumor imaging. In this report, a novel UCNP-based transport system is proposed for the delivery of the hypericin (Hyp) photosensitizer into malignant tumors. Core–shell $NaYF_4:Yb^{3+},Er^{3+}@NaYF_4:Nd^{3+}$ UCNPs were prepared by thermal decomposition and coated with poly(*N,N*-dimethylacrylamide-*co*-2-aminoethyl acrylate)-alendronate [P(DMA-AEA)-Ale], which endowed them with colloidal and chemical stability; finally, Hyp was conjugated. Internalization of CS-UCNP@P(DMA-AEA)-Ale-Hyp nanoparticles by Jurkat cells was successfully validated by multimodal imaging using a microstructural chamber, upconversion luminescence, and Raman microspectroscopy. After irradiation at 590 nm, CS-UCNP@P(DMA-AEA)-Ale-Hyp nanoparticles provided a markedly more effective photodynamic effect than Hyp alone at identical Hyp concentrations due to apoptosis as confirmed by caspase-3 activation. MTT assays showed that Hyp-free nanoparticles were non-cytotoxic, whereas CS-UCNP@P(DMA-AEA)-Ale-Hyp particles significantly reduced cell viability after irradiation. Considering that Hyp release from the nanoparticles was higher in the acidic environment typical of tumors compared to physiological ones, UCNP@P(DMA-AEA)-Ale-Hyp particles are a suitable candidate for future *in vivo* applications.

Keywords: upconversion; nanoparticles; core-shell; hypericin; imaging.

Intraperitoneal *versus* intravenous administration of Flamma®-conjugated PEG-alendronate-coated upconversion nanoparticles in mice pancreatic cancer model. Vasylyshyn T., Patsula V., Větvička D., Shapoval O., Pankrác J., Kabešová M., Beneš J., Horák D., *Nanoscale Adv.* 7, 144-154 (2025).

Abstract. Pancreatic cancer is one of the most common forms of malignant disease with a poor survival prognosis. Currently, nanomedicine holds great promise for targeted diagnosis and treatment of this cancer, which also reduces toxic side effects. In this work, we prepared PEG-coated monodisperse upconversion nanoparticles (UCNPs) with a conjugated Flamma® fluorescent dye for imaging and detection of particle distribution *in vivo*. We performed a thorough physicochemical characterization of the particles and determined their colloidal and chemical stability in several aqueous media such as water, PBS, Dulbecco's modified Eagle's medium and artificial lysosomal fluid. Luminescence resonance energy transfer from the emission of UCNPs as a donor to the Flamma® as an acceptor was confirmed. Intraperitoneal *versus* intravenous administration was then compared in terms of biodistribution of particles in various organs in the orthotopic mice pancreatic cancer model. The intraperitoneal route was preferred over the intravenous one, because it significantly increased the accumulation of particles in the tumor tissue. These new UCNP@Ale-PEG-Flamma® nanoparticles are thus promising for new treatment avenues for pancreatic cancer.

Keywords: upconversion nanoparticles; PEG-alendronate; Flamma®; pancreas.

Liraglutide-conjugated poly(methyl vinyl ether-*alt*-maleic acid)-coated core-shell upconversion nanoparticles for theranostics of diabetes. Shapoval O., Engstová H., Šlouf M., Kočková O., Dlasková A., Jabůrek M., Halili A., Mozheitová A., Jirák D., Ježek P., Horák D., *ACS Appl. Mater. Interfaces* 17, 42863−42876 (2025).

Abstract. In the diagnostics of diabetes, specific targeting of drugs (e.g., liraglutide) to insulin-deficient β-cells with their simultaneous noninvasive imaging is currently needed. In this report, liraglutide (LGL)-conjugated poly(methyl vinyl ether-*alt*-maleic acid) (PMVEMA)-coated core–shell $NaYF_4$:Yb,Er,Fe@$NaYF_4$:Nd upconversion nanoparticles (CS-UCNPs) have been developed, thoroughly physicochemically characterized, and evaluated in vivo. Novel codoping of Fe^{2+}, Y^{b3+}, and Er^{3+} ions in the host $NaYF_4$ induced upconversion emission in the red region at both 980 and 808 nm excitation, making the particles suitable for deep-tissue imaging. Surface functionalization with PMVEMA provided colloidal stability and facilitated covalent conjugation with LGL, enabling targeted binding to GLP-1 receptors on pancreatic β-cells, increasing glucose-stimulated insulin secretion from isolated Langerhans islets. Biocompatibility of CS-UCNP@PMVEMA-LGL nanoparticles was confirmed by the trypan blue dye exclusion assay. When the fluorescent dye Flamma was conjugated to the nanoparticles, in vivo fluorescence imaging revealed significantly enhanced accumulation of CS-UCNP@PMVEMA-LGL-Flamma nanoparticles in the pancreas 24 h after intramuscular injection compared with intravenous administration, with luminescence intensity approximately doubled. The improved pancreatic targeting efficiency was attributed to enhanced binding to GLP-1 receptors. Confocal microscopy and elemental analysis confirmed receptor-mediated uptake of the nanoparticles by internalization and their localization within pancreatic β-cells. These findings highlight the potential of CS-UCNP@PMVEMA-LGL nanoparticles as biocompatible targetable imaging agents with future applications in pancreatic diagnostics.

Keywords: liraglutide; poly(methyl vinyl ether-*alt*-maleic acid); upconversion; core-shell; photodynamic; diabetes.

Lanthanide-based UCNPs: Toxicity evaluation and interaction of ultrasmall core *vs*. core-shell nanoparticles with cells. Nahorniak M., Horák D., Šlouf M., Steinhart M., Shapoval O., Engstová H., Ježek P., *Mater. Adv.* 6, 6907-6918 (2025).

Abstract. We describe a new concept for preparation of ultrasmall $NaYF_4$:Yb,Er upconversion nanoparticles (UCNPs) with a diameter of 7 nm, depending on the amount of water added in the polymerization mixture, which affects the nucleation and growth of the particles. The morphology and structure of the nanoparticles were thoroughly characterized both in the dried state (TEM including elemental analysis and electron diffraction) and in solution (small and wide-angle X-ray scattering and dynamic light scattering). A thick $NaYF_4$ shell was subsequently introduced onto the particles, which significantly increased the luminescence by minimizing surface quenching effects and passivating the core from the surrounding environment. To make the particles dispersible in the aqueous environment natural for biological applications, they were coated with a ~6 nm thick hydrophilic silica layer. This increased the size of core and core–shell UCNPs to 20 and ~50 nm. All the developed particles exhibited non-cytotoxicity tested in insulinoma INS-1E cells. The upconversion luminescence of these nanoparticles incubated with INS-1E cells showed a similar pattern to that of the particles themselves. The small biocompatible UCNPs developed in this study are promising candidates for non-invasive and non-destructive applications in bioimaging. Thanks to their advantageous properties, i.e., small size, adjustable optical properties and ability to interact with and easily penetrate cells, they are suitable for future use in platforms for targeted drug delivery and advanced diagnostic technologies.

Keywords: upconversion; nanoparticles; ultrasmall; core-shell; toxicity.

Contribution: Dr. Patrick LACROIX-DESMAZES & Dr. Julien PINAUD

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Contribution to IPCG Newsletter

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Recently published or submitted articles and articles in preparation:

1."Mesoporous silica for sustainable dye removal: fast and reversible adsorption from ordered mesopores densely functionalized with polymers" J. Richard, A. Vashishtha, A. Phimphachanh, G. Rydzek, P. Lacroix-Desmazes, N. Marcotte, C. Gérardin. ***Microporous and Mesoporous Materials*** **2024**, *379,* 113254*;*
https://doi.org/10.1016/j.micromeso.2024.113254

Functionalized mesoporous silica particles offer excellent chemical and morphological properties, making them ideal adsorbents or drug carriers. However, their synthesis involves several energy- and resource-intensive steps, resulting in high economic and environmental costs. In this study, we report a strategy for the direct design of mesoporous silica with ordered mesopores densely functionalized by polyacid chains. The aqueous process relies on polyion complex micelles acting as pH-responsive multifunctional agents. They are first associated to direct the mesostructure of silica, and are then dissociated by a change in pH to reveal the material's mesoporosity and yield functional pores. Ordered mesoporous particles with controlled structure and particle size were obtained, showing dense functionalization of up to 2.1 mmol.g_{SiO2}^{-1} of carboxylic acid functions, which were fully accessible to ionic exchange in aqueous solution. These highly functionalized materials were then evaluated as reversible adsorbents for the removal of a cationic dye (auramine O). The results revealed high dye uptakes, from 130 to 237 mg.g_{SiO2}^{-1}, which were up to 193 % higher than those achieved with non-functional calcined mesoporous silica particles. These uptakes correlated with the mesoporous volume of the materials, with an average density of around one auramine molecule per nm3 of pore. In addition, the materials exhibited excellent dye adsorption/desorption cyclability by pH stimuli in aqueous solutions under mild conditions, with an average desorption efficiency of 96 % in just 30 min. These results therefore represent an attractive strategy for the design of efficient and sustainable adsorbents for water purification.

2."Switchable pH-Responsive Morphologies of Coassembled Nucleobase Copolymers" L. Vasilica Arsenie, M. Semsarilar, B.T. Benkhaled, A. Geneste, B. Prélot, O. Colombani, E. Nicol, P. Lacroix-Desmazes, V. Ladmiral, S. Catrouillet ***Biomacromolecules*** **2024***, 25,* 7225-7236; *https://doi.org/10.1021/acs.biomac.4c00901*

This work presents supramolecular coassembled nucleobase copolymers with transitional morphologies upon pH changes (from 7.4 to 10). Uracil- and adenine-containing copolymers were prepared by RAFT, which allowed us to finely tailor the polymerization degree and the composition. The coassembled formulations prepared in an aqueous buffer at two distinct pH (7.4 and 10) formed spherical morphologies at physiological pH. The increase of the pH induced the apparition of various large, irreversible anisotropic supramolecular architectures. Isothermal titration calorimetry revealed that the coassembly at pH 7.4 was mainly guided by H-bonds between complementary nucleobases, while the experiments conducted at pH 10 showed that the assemblies were mainly driven by hydrophobic interactions. These results highlight that the nature of supramolecular interactions (H-bonds or hydrophobic interactions) has a great influence on the morphology of nucleobase-containing coassemblies when changing the pH. These findings may provide further perspectives in the field of advanced nanomaterials.

3."Cellulose Nanocrystals Modified with Cationic Block Copolymers" O.L. Torres-Rocha, J. Pinaud, P. Lacroix-Desmazes, P. Champagne, M.F. Cunningham ***Biomacromolecules*** **2025***, 26,* 1978−1991; *https://doi.org/10.1021/acs.biomac.4c01802*

Cellulose nanocrystals (CNC) offer unique mechanical and optical properties but face challenges that often prevent its commercial development, foremost its high hydrophilicity, which makes it incompatible with most polymers. Covalent polymer graft modification can address this issue; however, these processes are often complex and expensive. We present a simple, inexpensive route for the noncovalent modification of a CNC surface with block copolymers. Five new block copolymers, composed of a butyl vinyl imidazolium bromide anchoring (cationic) and a nonionic stabilizing block, were synthesized via nitroxide-mediated polymerization. The degree of polymerization (DPn) of the stabilizing and anchoring blocks was systematically varied. Dispersibility of modified CNC in various organic solvents was evaluated. It was found that the DPn of both the anchoring and stabilizing blocks has a significant impact on the amount of the polymer that can be noncovalently bound to the CNC surface as well as in dispersibility in various solvents.

4."Benzo-12-crown-4-ether-mediated lithium transport in supercritical CO_2: A preliminary study for recycling lithium-ion battery cathode materials" R. Mondal, N. Stoffregen, J. Vauloup, C. Bouilhac, N. Coppey, L. Monconduit, M. Sougrati, L. Stievano, P. Lacroix-Desmazes ***Chemical Engineering Journal Advances*** **2025**, *24*, 100883. https://doi.org/10.1016/j.ceja.2025.100883

The design of metal-complexing copolymer architectures is essential to enable solvent-free recovery of critical metals, and of interest for a large number of applications. In this study, the lithium transport efficiency of benzo-12-crown-4-ether (B12C4) from various salts ($LiNO_3$, LiOAc, Li_2SO_4 and Li_2CO_3) in supercritical carbon dioxide ($scCO_2$) was investigated. Among these salts, only Li^+ from $LiNO^3$ was effectively complexed by B12C4 in $scCO_2$. As both B12C4 and the [B12C4-Li]NO_3 complex are poorly soluble in $scCO_2$, a $scCO_2$-philic gradient polymer, poly(B12C4 ethyl methacrylamide-grad-1,1,2,2-tetrahydroperfluorodecyl acrylate) [P(B12C4EMAAm-*grad*-FDA)] was synthesized by RAFT polymerization. In this copolymer, the FDA unit is CO_2-philic, while B12C4EMAAm acts as a metal-complexing group. The solubility of the copolymer was determined by cloud point measurement and compared to that of a PFDA homopolymer. The lithium recovery yield from lithium nitrate, quantified by inductively coupled plasma optical emission spectroscopy (ICP-OES) analysis, reached 83 % under supercritical conditions (40 °C and 250 bar) in the presence of a small amount of water (molar ratio [water]/[$LiNO_3$]=7.6), whereas only 25 % was recovered under dry conditions. The Li^+ transport efficiency of the copolymer was also evaluated in the presence of cobalt ions. Using a mixture of lithium nitrate and cobalt nitrate hexahydrate (molar ratio [B12C4EMAAm]:[Li]:[Co]=3.6:1:1), recovery yields of 46 % and 84 % for lithium and cobalt were obtained, respectively. Despite its lack of selectivity toward lithium, P(B12C4EMAAm-*grad*-FDA) demonstrates strong potential as a complexing ligand for both lithium and cobalt under $scCO_2$ conditions.

5. "Vegetable Oil-Based Materials for Drug Delivery Systems and Wound Dressings" L.M. Favre, N. Masurier, A. Aubert-Pouëssel. ***Macromolecular Bioscience*** **2025**:e00486. https://doi:10.1002/mabi.202500486.

Vegetable oils are natural and renewable resources, mostly composed of triglycerides (fatty acid esters of glycerol). These molecules possess multiple reactive sites, which can be used for chemical functionalization to form epoxides, hydroxyls, and cyclic carbonates. Thanks to these added functions, polymerization can take place in order to form vegetable oil-based materials, such as polyesters, polyurethanes, or hybrid materials. The development of vegetable oil-based polymers has provided access to new materials with properties such as flexibility, biocompatibility, and biodegradability. Thus, these characteristics make them particularly well-suited for biomedical applications. In this review, we are focusing on vegetable oil-based materials developed as drug delivery systems and wound dressings.

6. "Critical Contribution of Mesoporosity to the Stability of Zeolitic Catalysts for Oleate Isomerization in Continuous Flow Reactor" J. Cantor, O. Gimello, M. Rivière, H. Petitjean, L. Bernardi, A. Aubert-Pouëssel, C. Guerrero-Fajardo, F. Di Renzo, N. Tanchoux, C. Gérardin. ***ChemCatChem,*** **2025**, *17 (6)*, e202401802. https://doi.org/10.1002/cctc.202401802

Two types of hierarchical micro-mesoporous materials, as prepared from the zeolites with structure of 10-MR (10-membered rings) ferrierite and 12-MR faujasite Y, have been tested as catalysts of isomerization of methyl oleate in continuous flow conditions. The catalysts have been characterized by X-ray diffraction (XRD), nitrogen physisorption, transmission

electron microscopy (TEM), NH3 thermal programmed desorption (TPD), and 27Al MAS NMR. The reaction products have been identified by GC–MS and MALDI–TOF/TOF–MS, quantified by GC–FID, and their cold-flow properties for use as diesel biofuel have been evaluated by differential scanning calorimetry (DSC). The preparations of catalysts by recrystallization in cetyltrimethylammonium (CTA) solution have produced different structural mesoporosity in the two kinds of zeolites, with filling of previous mesopores in faujasite and opening of a bottle-necked negative-crystal mesoporosity in ferrierite. This last type of material has remarkably improved the stability of the isomerization reactions, with 98 wt% conversion of methyl oleate and 55% selectivity of branched monoenoic fatty esters upon 8 h timeon-flow, an uncommon result among the literature available on the continuous-flow experiments. The better results obtained on ferrierite catalysts, with crystallization points on the average 8 °C lower than for faujasite catalysts, have confirmed the shape selectivity of ferrierite structure for alkene isomerization reactions.

7."Metals recovery by supercritical CO_2 processes: a focus on Li-ion battery metals extraction" J. Vauloup, R. Mondal, C. Bouilhac, M. Sougrati, L. Stievano, N. Coppey, L. Monconduit, P. Lacroix-Desmazes ***The Journal of Supercritical Fluids*** **2026**, *229*, 106794. https://doi.org/10.1016/j.supflu.2025.106794

As the demand for lithium-ion batteries (LIBs) continues to rise, recycling becomes essential to ensure a sustainable supply of critical raw materials while mitigating environmental impact. The European Union (EU) has set ambitious LIB recycling targets, emphasizing the need for innovative and cost-effective solutions. Although pyrometallurgical and hydrometallurgical processes currently dominate, emerging technologies such as supercritical carbon dioxide (scCO2)-based extraction offer promising alternatives. Continued research and investment in LIB recycling infrastructures are crucial to supporting the energy transition and securing raw material independence in the coming decades. This review begins with a general overview of LIBs, their end-of-life processes, and the market and geopolitical context of LIBs and electric vehicles (EVs). It then briefly presents the interactions between CO_2 and solutes, which play a key role in determining the solubility of substances in $scCO_2$. In the following, the current and potential uses of $scCO_2$ in the field of LIBs are reviewed, with particular attention to the extraction of metal, which represents a crucial and promising application of this green technology. This focus highlights the unique features and specific challenges associated with metal recovery using $scCO_2$. The main parameters influencing metal extraction, such as pressure, temperature, co-solvents, and complexing agents, are discussed. Finally, recent advances in the extraction of the metals contained in cathode active materials using $scCO_2$ are presented.

8."In situ saxs investigation of the formation of mesostructured materials structured from polyion complex micelles" J. Schmitt, E. Molina, J. Perez, P. Lacroix-Desmazes, C. Gerardin, N. Marcotte ***Microporous and Mesoporous Materials*** **2026**, *402*, 113964. https://doi.org/10.1016/j.micromeso.2025.113964

Polyion complex (PIC) micelles are highly efficient agents for directing the structure of silica. They are particularly attractive because they enable the direct preparation of functional

mesostructured materials by anchoring one of the two micellar constituents in the silica network, while allowing the other one to be released for recycling or for use in specific applications. Notably, the formation of these hybrid materials proceeds in a one-pot process under moderately acidic conditions. Despite their versatility and broad range of potential applications, their formation mechanisms have not yet been elucidated. In this work, we used in situ SAXS experiments to monitor the formation kinetics of a mesoPIC material formed from a polyion complex composed of poly(ethylene oxide)-*b*-poly(acrylic acid) (PEO-*b*-PAA) as a double hydrophilic block copolymer (DHBC) and neomycin (NM) as a micellizing agent. The results were benchmarked against the well-known SBA-15 silica material made with P123 copolymer, due to the similarity of the neutral poly(ethylene oxide) chain interacting with silica. The mechanisms of formation of the mesoPIC material resembles those already reported, involving the growth of silica oligomers and their integration into the micelle corona, followed by the formation of a 2D-hexagonal hybrid mesophase. Interestingly, a transient signal was detected during the kinetics, attributed to the formation of poorly organized packed silica-rich micelles present in large grain mesostructured material. The well-ordered final mesostructure together with the emergence and disappearance of the transient signal highlight the ability of the PIC system to reorganize dynamically into highly ordered mesostructured materials.

9."Multifunctional eugenol-enriched PEO-based electrospun and photo-crosslinked scaffolds for wound healing applications" A.C. Scalia, J.A. Talamo Ruiz, S. Dalle Vacche, R. Bongiovanni, P. Lacroix-Desmazes, A. Cochis, A. Vitale ***Applied Materials Today*** **2026**, *49*, 103136. https://doi.org/10.1016/j.apmt.2026.103136

The development of multifunctional wound dressings that simultaneously prevent infection and promote tissue regeneration remains a critical challenge in regenerative medicine. In this study, electrospun poly(ethylene oxide) (PEO)-based nanofibrous membranes were functionalized with eugenol (EU) and eugenol methacrylate (EUMA) as bioactive agents. The membranes were subsequently photo-crosslinked to enhance structural stability and biomedical applicability. Different concentrations of bioactive compounds were evaluated, and the optimized formulations produced scaffolds with uniform, defect-free fibers averaging 316–340 nm in diameter. Physico-chemical characterization confirmed that the scaffolds possess mechanical robustness, flexibility, hydrophilicity, and permeability, which are key requirements for effective wound dressing performance. Both EU- and EUMA-functionalized scaffolds were cytocompatible and non-toxic. In addition, they exhibited notable antibacterial and anti-biofilm activity. Membranes containing 5% EU showed superior inhibition of Gram-positive bacterial growth, whereas those incorporating 5% EUMA provided enhanced cytoprotective and pro-regenerative effects. In vitro wound-healing assays using human mesenchymal stromal cells demonstrated that EUMA-functionalized scaffolds achieved an 85% reduction in wound width within 24 h in a 2D model. Consistently, in a 3D reconstructed human epidermis model, both EU- and EUMA-doped scaffolds accelerated wound closure by approximately twofold compared to undoped PEO. This study thus provides a previously unexplored structure-function comparison between native eugenol and its methacrylated derivative incorporated into photo-crosslinked electrospun PEO scaffolds, elucidating how chemical modification governs the balance between antimicrobial and regenerative performance. Overall, the developed PEO-based nanofibrous scaffolds offer a scalable, cost-

effective, and versatile platform for next-generation smart wound dressings designed to support both infection control and tissue repair.

*10."*Synthesis and Processing of Polydepsipeptide- and Polylactic Acid-Based Microparticles with Tunable Degradation Profiles" Z. Garisoain, A. Voronova, E. Soddu, M. Desvignes, M. Colpaert, Y. Lannay, A. Aubert-Pouëssel, E. Belamie, J. Pinaud, O. Giani, ***Biomacromolecules*** **2026**, *27* (2), 1150-1167.https://doi.org/10.1021/acs.biomac.5c01264

Polydepsipeptides (PDPs) are biocompatible polymers, whose biodegradation releases only amino acids and glycolic or lactic acids, nontoxic compounds that are naturally present in the body. These polymers therefore have great potential as materials for use in biomedical applications, particularly as drug delivery systems. Here, we investigated the organocatalyzed ring-opening polymerization (OROP) of 3-benzylmorpholine-2,5-dione (MD(Phe)) using DBU and TU as the catalytic couple to synthesize PDP(Phe) with molar masses from 2.5 to 10 $kg \cdot mol^{-1}$. Copolymerization with lactide was also studied, with the aim of obtaining various degradation kinetics related to the enzymatic environment. PDP(Phe)- and P(MD-*co*-LA)-based microparticles were produced by microfluidics with diameters of 40–60 µm and narrow size distributions. Their degradation behavior was evaluated in PBS and in the presence of enzymes (esterase, α-chymotrypsin). Both PDP(Phe) and P(MD-*co*-LA) microparticles displayed composition- and environment-dependent degradation, releasing phenylalanine and hydrolyzed MD(Phe).

Work in progress:

Lucas FAVRE (PhD student, supervisors: Anne AUBERT-POUESSEL, Nicolas MASURIER) (2022-2025): *Biodegradable vegetable oil-based hybrid microparticles for a poorly water-soluble anti-melanoma molecule.*

Alexiane FERON (PhD student, supervisors: Sylvain CATROUILLET, Patrick LACROIX-DESMAZES, Marie MORILLE) (2023-2026): *Complexation by hydrogen bonds of mRNA by polymers integrating nucleic bases for the vectorization of nucleic acids.*

Maya JELEFF (PhD student, supervisors: Gaulthier RYDZEK, Corine GERARDIN; co-supervisors: Patrick LACROIX-DESMAZES, Sylvain CATROUILLET) (2024-2027): *Hybrid Polymer-functionalized Mesoporous Structures as new Versatile Adsorbents for Micropollutant Removal.*

Sarah ESSAYIE (PhD student, supervisors: Sylvain CAILLOL, Patrick LACROIX-DESMAZES; co-supervisors: Camille BAKKALI-HASSANI, Vincent LADMIRAL) (2024-2027): *Synthesis of non-isocyanate waterborne polyurethanes for coatings.*

Aline REBEJAC (PhD student, supervisors: Patrick LACROIX-DESMAZES, Julien PINAUD) (2025-2028): *Preparation of polymeric biodegradable microcapsules.*

Léo JEANDEL (PhD, supervisors: Patrick LACROIX-DESMAZES, Moulay Tahar SOUGRATI; co-supervisors: Cécile BOUILHAC) (2026-2029): *Synthesis of polymers for*

supercritical CO_2 extraction of critical metals from spent Li-ion batteries. [polymer co-assembly in dispersed media is part of this work]

Célia GUILLEMOT (PhD student, supervisors: Eric LECLERC; co-supervisors: Vincent LADMIRAL, Sylvain CAILLOL, Patrick LACROIX-DESMAZES) (2026-2029): *Synthesis of depolymerizable polymers for applications in aqueous media.*

Loïg MARLEUX (Master student, supervisors: Cécile BOUILHAC, Patrick LACROIX-DESMAZES) (2026): *Synthesis of polymers for selective supercritical CO_2 extraction of lithium for Li-ion cathode materials. [polymer co-assembly in dispersed media is part of this work]*

Base-degradable Methacrylic Microcapsules Synthesized via Interfacial Radical Polymerization Using 4,4-Dimethyl-2-methylene-1,3-dioxolan-5-one (DMDL)

Gerald Tze Kwang Er, Lim Wei Xiang, and Atsushi Goto

Polym. Chem.. **2026**, *17*, 648−654

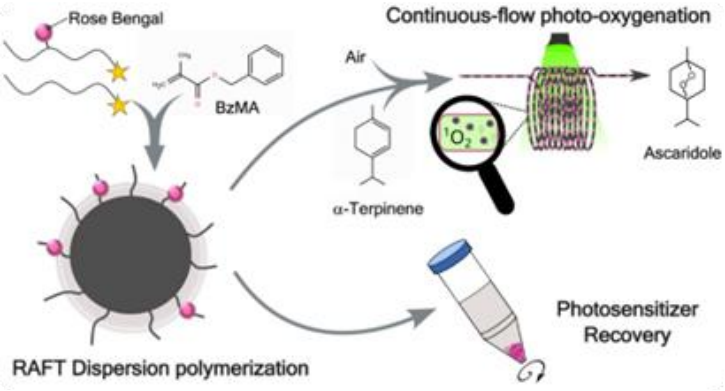
Abstract: Base-assisted degradable methacrylic polymer microcapsules were synthesized via interfacial radical polymerizations of oil-in-water emulsions containing 4,4-dimethyl-2-methylene-1,3-dioxolan-5-one (DMDL) as a monomer to provide degradable units in the obtained microcapsule shell. Many of the current degradable polymer microcapsules use ester linkages in the polymer backbones for degradation. The ester linkages incorporated in the polymer backbones can cause the polymers to be less stable, and the polymer microcapsules may gradually degrade hydrolytically under humidity. The DMDL units provide carbon-carbon linkages in the polymer backbones. The obtained microcapsules were stable in neutral aqueous conditions with various salts and selectively degraded in basic conditions. As demonstration, a dye was encapsulated and was gradually released over time in a basic aqueous condition. Possible long-term storage stability in aqueous neutral conditions and selective content release in basic conditions may be an advantage of the DMDL microcapsules.

Contribution: Dr. Maud Save

Recently submitted article

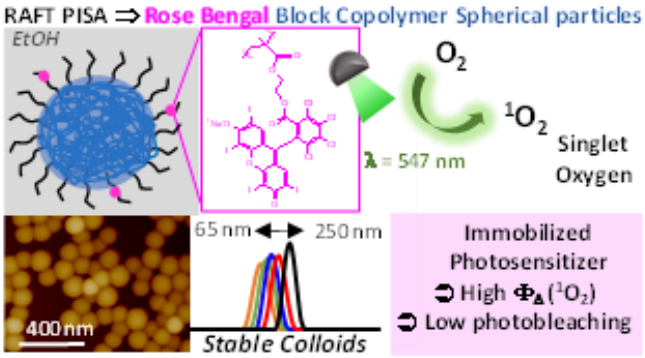
Tuning Polymer Shell of Rose Bengal-Anchored Latex Synthesized by dispersion Polymerization: Photoreactivity, Recovery and Use in Continuous Flow Photooxygenation (submitted)

Guillaume Mageste, Bastien Lopez, Chaima Mahmoudi, Axelle Desriac, M. Ali Aboudzadeh, Jean-François Blanco, Mickaël Le Bechec, Thierry Pigot, Karine Loubiere, Christophe Chassenieux, and Maud Save*



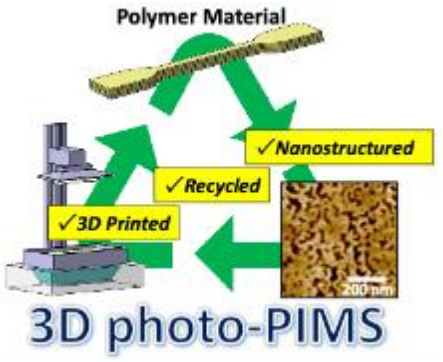
Engineering Rose Bengal-Decorated Core-shell Latex by RAFT Dispersion PISA for Photosensitized Singlet Oxygen Generation (submitted)

M. Ali Aboudzadeh, Guillaume Mageste, Mickaël Le Bechec, Virginie Pellerin, Thierry Pigot and Maud Save*



Crosslinker-Free Photo-Polymerization Induced Microphase Separation Toward Nano-Structured Recyclable 3D Printed Polymer Materials *(under revision)*

Grégoire Lahittete[1], Virginie Pellerin[1], Anne-Laure Brocas[2], Christophe Derail[1], Maud Save[1], Laurent Rubatat[1*]



List of recently published articles

❑ *"Robust Pickering emulsions stabilized with pH-responsive self-assembled amphiphilic tadpole bottlebrush copolymers: bulk reversibility of the self-assembly is lost at the interface."* Clément Goubault; Julien Rosselgong; Gireeshkumar Balakrishnan Nair; Elise Deniau; Maud Save; Christophe Chassenieux, Véronique Schmitt *Journal of Colloid & Interface Science* **2026,** DOI 10.1016/j.jcis.2026.140019

❑ *"Continuous Flow Photooxygenation with Advanced Rose Bengal-Anchored Polymer Colloids"* Axelle Desriac, Guillaume Mageste, Mickael Le Bechec, M. Ali Aboudzadeh, Thierry Pigot, Maud Save, Jean-François Blanco, Patrice Bacchin, Karine Loubiere *Reaction Chemistry & Engineering* **2025,** DOI

❑ *"Lithium Salt-Induced Microphase Separation in Photopolymerized Solid Polymer Electrolytes"* Kingsley Ikenna Aniagbaoso, Monika Król, Janne Ruokolainen, Antoine Bousquet, Maud Save, Laurent Rubatat *Applied Materials Today* **2025,** DOI 10.1016/j.apmt.2025.102946

❑ *"Amphiphilic Poly(-Myrcene-Co-Acrylic Acid) Copolymers Synthesized by Nitroxide-Mediated Copolymerization as Stabilizer of Terpene-Based Waterborne Latex"*
Safae Azekriti, Karim Mehenaoui, Francis Ehrenfeld, Anthony Laffore, Maud Save *Biomacromolecules* **2025,** *26*, 1111−1127 DOI 10.1021/acs.biomac.4c01444 (***Published as part of Biomacromolecules special issue "Fundamentals of Polymer Colloids"***).

❑ *"In Situ Fabrication of Quasi-Solid Polymer Electrolytes for Lithium Metal Battery via Photopolymerization-Induced Microphase Separation"*
Kingsley Ikenna Aniagbaoso, Jan Bitenc, Virginie Pellerin, Maud Save, Antoine Bousquet, Laurent Rubatat *ACS Applied Materials & Interfaces* **2025** DOI 10.1021/acsami.4c15921

Recently defended PhD Theses

Guillaume Mageste, PhD defense on 1st December 2025
"Advanced photo-active polymer colloids synthesized by RAFT polymerization in dispersed media for interfacial photosensitized singlet oxygen production: towards sustainable processes"
Supervisors: Maud Save (IPREM, CNRS, University of Pau, France), Thierry Pigot (UPPA, IPREM)
The APOFLOW program funded by ANR involved three academic French laboratories IPREM-Pau (Dr. Maud Save); IMMM-Le Mans (Prof. Christophe Chassenieux), LGC-Toulouse (Dr. Karine Loubière).

Safae Azekriti, PhD defense on 14th March 2025
"Synthesis of terpene-based materials: amphiphilic copolymers as stabilizers for the design of biobased waterborne latex and polymer films."
Supervisors: Maud Save (IPREM, CNRS, University of Pau, France)

PhD Theses in progress

Nabil Mebrouk, Oct 2022 - Sept 2025 (UPV-UPPA joint supervision program)
"Nitroxide-Mediated Polymerization-Induced Microphase Separation (PIMS): from time-resolved data collection to kinetic modelling"
Supervisors: Laurent Rubatat (IPREM, CNRS-UPPA, France), Shaghayegh Hamzehlou (POLYMAT, UPV)
Co-supervisors: Maud Save (IPREM, CNRS-UPPA), Jossera Leiza (POLYMAT, UPV)

Post-doc in progress

Mario Penas, June 2023 – May 2023 – MSCA H2020 Fellowship
"Synthesis and nanostructural study of amphiphilic copolymer additives within a matrix of bioplastics"
Co-Supervisors from IPREM, CNRS, University of Pau, France: Maud Save, Laurent Rubatat and Susana Fernandes

Contribution: Prof Per B. Zetterlund

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Recently published papers

- Gradient and Core–Shell Waterborne Polymer Nanoparticles: Effects of Particle Morphology on Coating Performance, Y. Fadil, F. Jasinski, M. Mballa Mballa, R. P. Kuchel, S. C. Thickett, R. H. G. Brinkhuis, P. B. Zetterlund, *Industrial & Engineering Chemistry Research* **2026**, *65*, 1189−1197.

- Self-Assembled Polymeric Nanofibers as "Smart" Thermoresponsive Viscosity Modifiers, F. Ishizuka, H. J. Kim, R. P. Kuchel, P. T. Spicer, S. Chatani, H. Niino, P. B. Zetterlund, *ACS Applied Polymer Materials* **2025**, *7*, 16374−16381.

- Degradable Polymer Films: RAFT-mediated Emulsion Copolymerization of Lipoic Acid with Vinyl Monomers, S. W. Thompson, Y. Fadil, N. J. Chan, G. Moad, S. Perrier, P. B. Zetterlund, *Green Chemistry* **2025**, *27*, 14899 - 14910.

- Morphology Rearrangement by Mixing of Internally Hydrogen-Bonded Nanoparticles Comprising Triazine-Based Amphiphilic Diblock Copolymers, F. Haque, S. W. Thompson, F. Ishizuka, J. J. B. van der Tol, D. Singh, G. J. Sanjayan, P. B. Zetterlund, *Macromolecules* **2025**, *58*, 11611−11620.

- Plastics Recycling: A Comparative Study of Different Analytical Techniques, Md. L. Amin, L. N. M. Dinh, A. Rawal, P. B Zetterlund, V. Agarwal, *Macromolecular Materials and Engineering* **2025**, 0:e00195.

- Charge–Discharge Cycling at a Lithium-Conducting Organic Polymer-Modified Cathode/Sulfide Electrolyte Interface. K. Watanabe, H. S. Kim, Y. Hasegawa, S. W. Thompson, T. R. Guimarães, R. Kanno, P. B. Zetterlund, M. Hirayama, *RSC Applied Interfaces* **2025**, *2*, 1821-1828.

- Synthesis of Degradable Vinyl Copolymers Based on Lipoic Acid via *Ab Initio* Emulsion Polymerization. Y. Fadil, D. Fan, S. W. Thompson, P. B. Zetterlund, *ACS Sustainable Chemistry & Engineering* **2025**, *13*, 16117−16126.

- Polymer/(Nickel Nanowire)/Graphene Oxide Advanced Amphiphilic Nanocomposite Coatings. L. Xu, L. Amin, L. N. M. Dinh, S. H. Harun, Y. Yao, P. B. Zetterlund, V. Agarwal, *MRS Communications* **2025**, *15*, 705–713.

- Effect of High Filler Loading on Polymer/(Reduced) Graphene Oxide Nanocomposite Coatings. B. N. Tran, Y. Fadil, Y. Yao, V. Agarwal, P. B. Zetterlund, *RSC Applied Interfaces* **2025**, *2*, 1248-1258.

- Solution-Processable Polymer Nanocomposites for Electromagnetic Interference Shielding. T. S. Tran, L. Xu, P. B. Zetterlund, V. Agarwal, *Adv. Mater. Interfaces* **2025**, *12*, 2500225.

- Encapsulation of $LiCoO_2$ Particles with Lithium Containing Polymer for Solid State Lithium-ion Battery Cathodes. S. W. Thompson, T. R. Guimarães, K. Watanabe, M. Hirayama, P. B. Zetterlund, *Polymer* **2025**, *324*, 128255.

- Thin Spray-on Liners (TSLs) as Surface Support in Underground Mining: A Review. H. J. Kim, K. Li, S. Akdag, C. Zhang, J. Oh, P. Jiang, P. T. Spicer, P. B. Zetterlund, S. Saydam, *Construction and Building Materials* **2025**, *470*, 140432.

- RAFT Polymerization for Advanced Morphological Control: From Individual Polymer Chains to Bulk Materials, K. Hakobyan, F. Ishizuka, N. Corrigan, J. Xu, P. B. Zetterlund, S. W. Prescott, C. Boyer, *Adv. Mater.* **2024**, 2412407.

Contribution: Prof Dr. Habil. Leonard Atanase

Articles published in 2025:

16. Losetty, V., Lakkaboyana, S.K., Chappidi, H.Y., Venkateswarlu, K., Trilaksana, H., Koduru, J.R., Yuzir, A., Atanase, L.I., Seepana, P.K., Knani, S. Transformative Applications of Polymer-Based Metal Oxide Nanocomposites in Medicine, Industry, and Environmental Remediation: A Review. *J. Inorg. Organomet. Polym.***(IF = 4.9) 2025**.

15. El Yousfi, R.; Farcas, E.; Atanase, L.I.; Delaite, C.; Achalhi, N.; Choukri Belkadi, M.; El Idrissi, M. Interaction-driven thermodynamic sol-gel mechanisms and gelation behavior of PEG-based multi-branched PCL copolymers toward injectable biodegradable hydrogels, *J. Mol. Liq.* **2025**, 437, 128322, https://doi.org/10.1016/j.molliq.2025.128322.

14. Fuioaga, P.C.; Rata, D.M.; Riaz, T.; Rivero, G.; Abraham, G.A.; Atanase, L.I. Composite Hydrogels with Embedded Electrospun Fibers as Drug Delivery Systems. *Gels* **2025**, *11*, 826. https://doi.org/10.3390/gels11100826

13. Schuller, A.S.; Girault, E.; Amdouni, S.; Atanase, L.I.; Horhogea, C.E.; Leclinche, F.; Delaite, C. Optimization of the electrospinning process to create an active bilayer nanostructured wound dressing based on PLA and Ibuprofen. *J. Appl. Polym. Sci.* **2025**, 142, e57726. https://doi.org/10.1002/app.57726

12. Cadinoiu, A.N., Rata, D.M., Atanase, L.I., Ichim, D.L., Gherghel, D., Condriuc, I.P., Mihai, C.T., Popa, M., Jerome, C., Calin (Mihalache), G. Physicochemical characterization and in vitro evaluation of peptide-functionalized microspheres based on carboxymethyl chitosan and poly(vinyl alcohol) as promising pulmonary drug delivery system. *Appl. Mater. Today*, (IF = 7.2) 2025, 44, 102778. https://doi.org/10.1016/j.apmt.2025.102778

11. El Yousfi, R., Atanase, L.I., Makaoui, A., Achalhi, N., Belkadi, M.C., Dalli, M., El Idrissi, A. Enhanced Quercitin encapsulation through charge density and amphiphilicity tuning in cationic triblock micelles. *ACS Appl. Polym. Mater.* (IF = 4.5) 2025, https://doi.org/10.1021/acsapm.5c00806

10. Rata, D.M., Cadinoiu, A.N., Vochita, G., Gherghel, D., Lakkaboyana, S.K., Fuioaga, C.P., Atanase, L.I., Ichim, D.L. Biocomposite complex hydrogels with antimicrobial activity suitable for wound healing. *J. Polym. Sci.* (IF = 3.9) 2025, *63*, 1878-1890. https://doi.org/10.1002/pol.20241166

9. Babutan, I.; Atanase, L.I.; Botiz, I. Self-Assembly of Lamellar/Micellar Block Copolymers Induced Through Their Rich Exposure to Various Solvent Vapors: An AFM Study. *Materials* 2025, *18*, 1759. https://doi.org/10.3390/ma18081759

8. Biswas, R.; Mondal, S.; Ansari, M.A.; Sarkar, T.; Condiuc, I.P.; Trifas, G.; Atanase, L.I. Chitosan and Its Derivatives as Nanocarriers for Drug Delivery. *Molecules* (IF = 4.2) 2025, *30*, 1297. https://doi.org/10.3390/molecules30061297

7. Cadinoiu, A.N.; Rata, D.M.; Daraba, O.M.; Atanase, L.I.; Horhogea, C.E.; Chailan, J.-F.; Popa, M.; Carauleanu, A. Metronidazole-Loaded Chitosan Nanoparticles with Antimicrobial Activity Against *Clostridium perfringens*. *Pharmaceutics* (IF = 4.9) 2025, *17*, 294. https://doi.org/10.3390/pharmaceutics17030294

6. Căprărescu, S.; Tihan, G.T.; Zgârian, R.G.; Grumezescu, A.M.; Lazau, C.; Bandas, C.; Atanase, L.I.; Nicolae, C.-A. Synthesis and Characterization of Cellulose Acetate/Polyethylene Glycol/Poly(Styrene)-b-Poly(4-Vinylpyridine) Membrane Embedded with Hydrotermaly Activated TiO_2 Nanoparticles for Waste-Waters Treatment by Membrane Processes. *Polymers* (IF = 4.7) 2025, *17*, 446. https://doi.org/10.3390/polym17040446

5. Baskar, S., Sidhaarth, K.R.A., Mangaleshwaran, L., Lakkaboyana, S.K., Trilaksana, H., Naidu Kalla, R.M., Lee, J., Atanase, L.I., Kazi, M., Praveenkumar, S. Elimination of nickel ions in a packed column using clamshell waste as an adsorbent. *Sci. Rep.* (IF= 3.8) 2025, 15, 32. https://doi.org/10.1038/s41598-024-82267-0

4. Raţă, D.M.; Cadinoiu, A.N.; Grădinaru, L.M.; Fuioaga, P.C.; Vochita, G.; Delaite, C.; Atanase, L.I. Design and characterization of curcumin-loaded electrospun nanofibers based on poly(vinyl alcohol) and sodium alginate. *Express Polym. Lett.* (IF = 2.7) 2025, 19, 233-245. https://doi.org/10.3144/expresspolymlett.2025.18

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2. Kadri, L. ; Salhi, S.; Schuller, A.S.; Atanase, L.I.; Delaite, C.; Ammar, H. Highly efficient one-pot synthesis of polyesteramides from ε-caprolactone and l-phenylalanine with high cell-viability and chemical stability. *Polymer* (IF = 4.1), 2025, 319,127981. https://doi.org/10.1016/j.polymer.2024.127981

1. Rata, D.M.; Cadinoiu, A.N.; Atanase, L.I.; Vochita, G.; Sande, S.A.; Popa, M. Peptide-functionalized magnetic microcapsules loaded with dexamethasone for dual active targeted treatment of inner ear inflammation, *Polymer* (IF = 4.1) 2025, 316, 127864. https://doi.org/10.1016/j.polymer.2024.127864

1) Ł. Otulakowski, D. Lipowska-Kur, M. Gadzinowski, S. Slomkowski, **T. Basinska**, A. Forys, B. Trzebicka. The synthesis and properties of brush-coil−brush (polyglycidol-*g*-polyglycidol)-*b*−polystyrene−*b*-(polyglycidol-*g*-polyglycidol) copolymers *J. Phys. Chem. B* 2025, *129*, 7406−7419. https://doi.org/10.1021/acs.jpcb.5c02760

The studies reported the synthesis and properties of brush-coil−brush amphiphilic (polyglycidol-*g*-polyglycidol)-*b*-polystyrene−*b*-(polyglycidol-*g*-polyglycidol) ((PGL-*g*-PGL)−PS−(PGL-*g*-PGL)) copolymers in an aqueous environment. Polystyrene terminated with hydroxyl groups at both ends served as a macroinitiator in the anionic polymerization of protected glycidol. After unblocking, the hydroxyl groups of the glycidol units in side chains were used to form grafts, and (PGL-*g*-PGL)−PS−(PGL-*g*-PGL) were obtained. The polystyrene central block contains 68 units, whereas the outer PGL-*g*-PGL blocks differ in the length of the main polyether chains and the number of glycidol units in grafts. Molar mass of copolymers was within the range of 14,500−18,200 g/mol. The copolymer chains self-assemble in water, forming regular core−shell micelles as found by DLS and cryo-TEM. Their critical micelle concentration (CMC) was determined by UV−vis and by DLS. CMC values were not simply related to the hydrophilicity of copolymer molecules expressed by the ratio of the number of −OH groups to the total units of the copolymer, but depended on the architecture of branched polyglycidol blocks. For the investigated brush-coil−brush copolymers, the CMCs were much higher than for linear triblock species with a similar length of PS blocks and PGL side chains. (PGL-*g*-PGL)−PS−(PGL-*g*-PGL) micelles were stable in time and resilient to temperature changes. The water contact angle determined under static conditions shows that a PGL chain architecture has a major influence on the wettability of polymer films saturated with water vapor.

2) D. Mickiewicz, M. Gadzinowski, S. Slomkowski, **T. Basinska**. Polymer prolate spheroids, ellipsoids, and their assemblies at interfaces—Current status and perspectives. *Materials* 2026, *19*, 291. https://doi.org/10.3390/ma19020291

Most nanoparticles and microparticles used as carriers of bioactive compounds are spherical in shape. Such particles are the easiest to obtain, as many processes spontaneously minimize the surface energy of the objects produced. However, in recent years, scientists have turned their attention to non-spherical particles in the hope of obtaining particles that interact with their environment in a tailored manner. The production of such particles should be easy and reproducible. The best candidates are spheroids produced by various methods. The most often used is the linear transformation of spheres during processes that preserve constant particle volume. The typical process consists of stretching a polymer matrix filled with spherical particles. The article delivers a critical overview of methods, discussing their advantages and disadvantages. A list of presented methods also includes the preparation of spheroids by

polymer solution emulsification-solvent evaporation, controlled dispersion polymerization, electrohydrodynamic jetting, adsorption of amphiphilic copolymers on solid particles, and copolymer self-organization processes, as well as microfluidic methods, deformation of spherical particles into spheroids by irradiation, and phase microseparation. A special section is devoted to the self-organization of the particles at the phase boundaries. Eventually, the preparation and selected properties of two-dimensional and three-dimensional assemblies of spheroidal particles, particularly the preparation of a quasi-nematic colloidal crystal, are discussed.

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Recently published papers:

1. Viernickel, J., Warnecke, F., Melchin, T., Zentel, K. M., Emulsion Polymerizations in a High-Pressure Semi-Batch Reactor – Sampling and Effect of Pressure. *Macromolecular Reaction Engineering* 19, 5 (**2025**): e70000. https://doi.org/10.1002/mren.70000

2. Issa, F., Reinbeck, A., Zentel, K.M., Modeling of Continuous Low-Temperature Emulsion Co-Polymerization in 3D-Printed Reactor. *Can. J. Chem. Eng*. (**2025)**, 1. https://doi.org/10.1002/cjce.70198

Spring 2026
Reported by: Michael F. Cunningham
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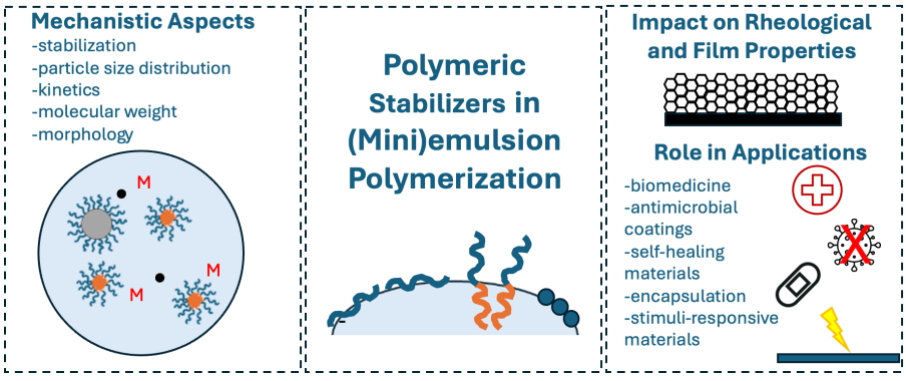
Manuscripts Accepted or Submitted for Publication

1.Smeltzer, S. E., & Cunningham, M. F. (2026). Design and Use of Amphiphilic Polymers as Stabilizers in (Mini)emulsion Polymerization. *Progress in Polymer Science*, 102090. https://doi.org/10.1016/j.progpolymsci.2026.102090 (Submitted)

Abstract: Small-molecule surfactants have long been a "necessary evil" in dispersed phase polymerizations as they are required to impart kinetic stability to a thermodynamically system, but their ability to readily diffuse to interfaces and leach from products leads to undesirable performance properties. The use of amphiphilic polymers as stabilizers in emulsion polymerization and miniemulsion polymerization (hereafter collectively referred to as "(mini)emulsion polymerization" presents a highly tunable option to help mitigate the associated drawbacks of small-molecule surfactants. Although the stabilizer is used in relatively small amounts (typically ~3 wt% of the total polymer), it has large impacts on (mini)emulsion polymerization from a mechanistic perspective as well as on final product properties. This review outlines considerations that need to be taken into account when using polymeric stabilizers in (mini)emulsion polymerization. For the convenience of the reader, this review starts with some background on (mini)emulsion polymerization and colloidal stabilization. Next, the mechanistic aspects to consider when using polymeric stabilizers in emulsion polymerization are outlined, with a large focus on the complexity of the nucleation stage. This discussion is then extended to miniemulsion polymerization. As stabilizers are present on the particle surface post-polymerization, the impact on rheological properties and film formation is then discussed, followed by various applications of polymer particles enabled using polymer particles. Special focus is drawn to how the stabilizer itself can be used to tailor the surface of particles for various applications. Finally, we conclude with a summary and an outlook on the state of polymeric stabilizers in (mini)emulsion polymerization.



2. Olga Torres-Rocha, Maedeh Ramezani, Michael Cunningham and Philip G. Jessop. Synthesis of lignin nanoparticles using CO_2-responsive amines and their performance as UV-light shields (Submitted)

Abstract: Lignin is biosourced, abundant, biodegradable, renewable and therefore an appealing feedstock from which to make materials for applications in diverse fields. In this work, we report initial results of a new method to produce lignin nanoparticles (LNP) with a tailored particle size. Lignin is first dispersed at elevated pH in an aqueous solution of a CO_2 responsive amine, after which the addition of CO_2 at atmospheric pressure induces precipitation of the lignin as nanoparticles. Two different CO_2-responsive amines, TMBDA (N,N,N',N'-tetramethyl-1,4-butanediamine) and TMTAD (2,6,10-trimethyl-2,6,10-triazaundecane), were evaluated for their effect on the lignin particle size and yield. For both amines, particle sizes were in the range of 125-175 nm with narrow particle size distributions. Yields were >84% for TMBDA and >94% for TMTAD. These LNP, when dispersed in poly(vinyl alcohol) (PVA) films, provide promising UV blockage even at low LNP content.

A greener process to transform lignin into lignin nanoparticles using ***CO_2-switchable*** technology and its use for UV-light shielding.

3. Raz Abbasi, Quynh Anh Ngo, addie Ho, Philip G. Jessop, and Michael F. Cunningham. CO_2-Switchable Surfactants in the Preparation and Application of BA/MMA Copolymer Latexes: Effect of Switchable Group Basicity on Polymerization and Coating Properties (Submitted)

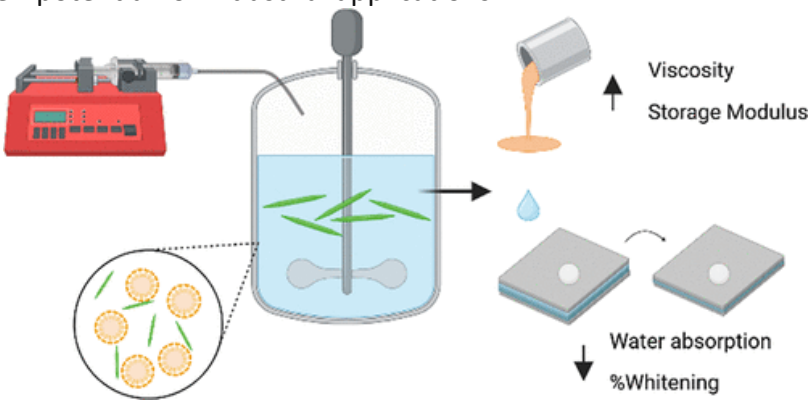
Abstract: CO_2-switchable surfactants enable surface activity during processing but deactivate later, ideal for latex coatings where charged surfactants are used to stabilize the formulation but the presence of charged species in the final coating negatively impacts the coating performance. In this study, surfactants with CO_2-switchable functional head groups including imidazole (C_{12}Im), tertiary aminoethoxy (C_{10}EDMA), and tertiary amine (C_{12}DMA), were applied in the emulsion copolymerization of butyl acrylate (BA) and methyl methacrylate (MMA) using VA-061 as a CO_2-switchable initiator. A lower-basicity surfactant produced larger latex particles, whereas higher-basicity surfactants stabilized smaller latex particles at lower concentrations. ATR-FTIR analysis indicated residual bicarbonate species

in dried films, likely from the initiator, the most basic component. Coatings made with CO_2-switchable surfactants exhibited improved water resistance, greater hydrophobicity, and enhanced corrosion protection relative to coatings with permanently charged surfactants. These findings highlight the critical role of surfactant basicity in governing both polymerization and coating performance.

Recent Publications

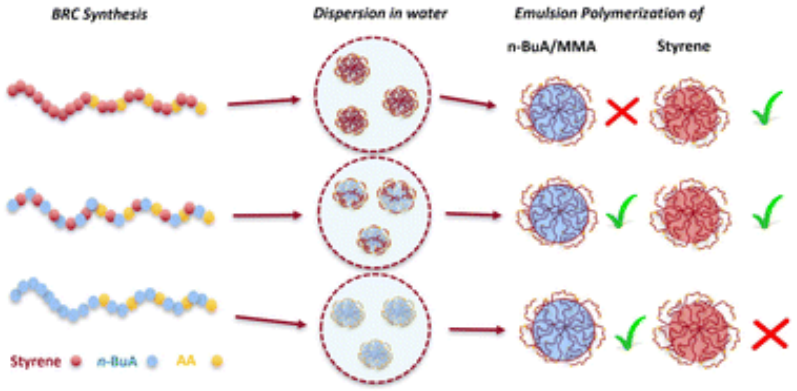
1.Ordoñez, Carolina, Marc A. Dubé, Emily D. Cranston, Marianna Kontopoulou, Timothy Morse, Gary A. Deeter, Pascale Champagne, and Michael F. Cunningham. "Enhancing the Properties of Latex-Based Coatings with Carboxylated Cellulose Nanocrystals." ***Biomacromolecules*** **26, no. 1 (December 19, 2024): 480–89. https://doi.org/10.1021/acs.biomac.4c01279.**

Abstract: Latex-based nanocomposites containing carboxylated cellulose nanocrystals (cCNCs) were synthesized via in situ seeded semibatch emulsion polymerization. Inspired by nature's use of CNCs to enhance rigidity and mechanical strength in cellulosic materials, we explored similar principles to improve the properties of acrylate water-based coatings. The cCNCs, loaded at 0.3–1.0 wt %, were added 1 h after pre-emulsion feeding began, addressing sensitivity to ionic strength and enabling stable final latexes. Careful control of the polymerization process maintained consistent particle sizes across formulations, allowing for mechanical property comparisons. Films from these latexes were evaluated through rheological and water sensitivity tests. With 1.0 wt % cCNC, significant increases in viscosity, shear-thinning behavior, stiffness, and elastic modulus were observed. Additionally, cCNCs reduced water and moisture absorption without affecting the whitening resistance. These findings demonstrate the enhanced properties of in situ cCNC latex nanocomposites, broadening their potential for industrial applications.



2. Werner, A., Sanders, C. A., Smeltzer, S. E., George, S. R., Gernandt, A., Reck, B., & Cunningham, M. F. (2025). Amphiphilic block-random copolymer stabilisers: extension to other monomer types. ***Polymer Chemistry***, ***16***(8), 979–986. https://doi.org/10.1039/d4py01321b

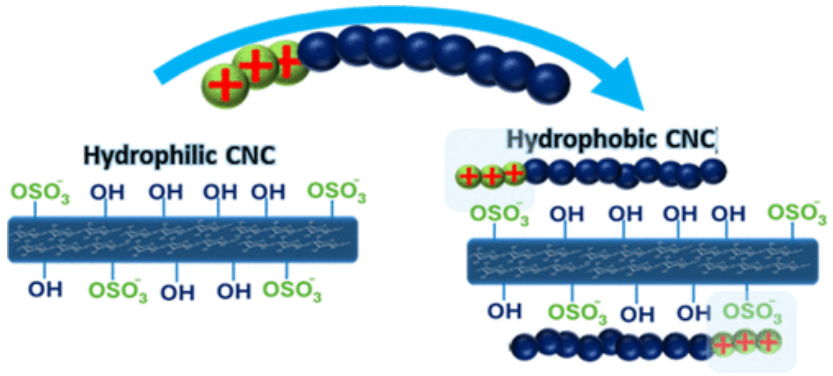
Abstract: Block-random copolymers (BRCs) incorporating acrylics were synthesised using nitroxide-mediated polymerisation (NMP) to form macro-stabilisers for the preparation of polymer latexes. These hybrids of block copolymers and random copolymers are traditionally composed of a polystyrene hydrophobic block coupled with a hydrophilic random block of styrene and acrylic acid. Their aqueous dispersions exhibit unique behaviour compared to conventional block copolymers, including being responsible for a unique nucleation mechanism in emulsion polymerisation. However, all previous work has only used styrene as the hydrophobic monomer, and only styrene emulsion polymerizations have been conducted. To explore the versatility of BRCs for the polymerisation of monomers other than styrenics (*e.g.* acrylates, methacrylates), the BRC library was explored with the introduction of methyl methacrylate (MMA) and *n*-butyl acrylate (*n*-BuA) units as the hydrophobic monomers. With blocks composed of one or multiple monomers, all the BRCs were successfully dispersed in water at high concentrations (>100 g L^{-1}), with similar behaviour compared to previously reported for styrene-based BRCs. Semi-batch emulsion polymerisation of styrene or acrylates latexes was also performed. A hydrophobic block consisting of a *n*-BuA and styrene copolymer was found to be of the most interest, showing promising stability over the range of latexes polymerised.



3. Torres-Rocha, O. L., Pinaud, J., Lacroix-Desmazes, P., Champagne, P., & Cunningham, M. F. (2025). Cellulose Nanocrystals Modified with Cationic Block Copolymers. *Biomacromolecules*, *26*(3), 1978–1991. https://doi.org/10.1021/acs.biomac.4c01802

Abstract: Cellulose nanocrystals (CNC) offer unique mechanical and optical properties but face challenges that often prevent its commercial development, foremost its high hydrophilicity, which makes it incompatible with most polymers. Covalent polymer graft modification can address this issue; however, these processes are often complex and expensive. We present a simple, inexpensive route for the noncovalent modification of a CNC surface with block copolymers. Five new block copolymers, composed of a butyl vinyl imidazolium bromide anchoring (cationic) and a nonionic stabilizing block, were synthesized

via nitroxide-mediated polymerization. The degree of polymerization (DPn) of the stabilizing and anchoring blocks was systematically varied. Dispersibility of modified CNC in various organic solvents was evaluated. It was found that the DPn of both the anchoring and stabilizing blocks has a significant impact on the amount of the polymer that can be noncovalently bound to the CNC surface as well as in dispersibility in various solvents.



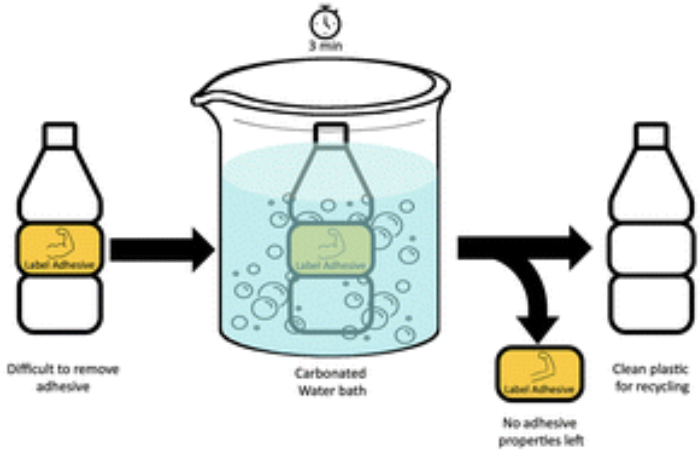
4. Mohebbi, Sara, Robin A. Hutchinson, and Michael F. Cunningham. "Exploring Bio-based Monomers in Emulsion and Miniemulsion Polymerization." ***Macromolecular Rapid Communications*** **46, no. 12 (March 5, 2025). https://doi.org/10.1002/marc.202401097.**

Abstract: Sustainability is a key priority in polymer synthesis, aiming to reduce reliance on nonrenewable resources by using greener components in the polymerization process. Emulsion polymerization stands out as an environmentally friendly method for producing polymers due to its utilization of water as a dispersant. The use of renewable, bio-based materials in emulsion polymerization formulations further enhances the process sustainability. This review examines recent advancements in bio-based monomers as sustainable alternatives to petroleum-based monomers in emulsion and miniemulsion polymerization. These bio-based monomers include vegetable oils, lignin derivatives, terpenes, proteins, and carbohydrates. The most notable bio-based monomers from each category is examined, reviewing their incorporation into (mini)emulsion polymerization, the polymerization processes involved, the properties of the resulting products, and their diverse applications.

5. Barker, Daniel, Shannon Whitty, Tobias Robert, Parisa Bayat, Marc A. Dubé, Michael F. Cunningham, Guojun Liu, and Philip G. Jessop. "Using a Bioderived CO2-Responsive Polymer as an Easily Removed Pressure Sensitive Adhesive." ***Green Chemistry*** **27, no. 31 (2025): 9531–40. https://doi.org/10.1039/d5gc00630a.**

Abstract: Pressure sensitive adhesives (PSAs) are used extensively in industry for adhering labels onto substrates. These labels are expected to adhere to the desired substrate during

use but be easily removed after serving their purpose. However, strong PSAs can be difficult to remove and can cause significant frustration to consumers and the recycling industry. These conflicting properties of excellent adhesion during use but easy removal at the end-of-life require the material to switch its properties. We have developed a bioderived CO_2-responsive adhesive synthesized from a castor oil derivative. The inclusion of CO_2-responsive groups allows the bioderived polymer to be readily dissolved into carbonated water. Removal of CO_2 and water produces a PSA which displays excellent adhesion comparable to that of commercial cellophane tapes. This new PSA adheres to many common packaging materials such as plastics, metals, and wood. The PSA displays excellent water resistance even after 5 days submerged in neutral water, with no observable loss in adhesive performance. However, exposure to carbonated water causes the PSA to separate easily from the substrate. This bioderived CO_2-responsive PSA potentially offers practical advantages in many applications including facilitating the removal of labels from used containers before recycling.



6. Monteiro, Michael J., and Michael F. Cunningham. "Polymer Colloids: Evolution of the Field toward Biomacromolecules." *Biomacromolecules* 26, no. 8 (August 11, 2025): 4733–34. https://doi.org/10.1021/acs.biomac.5c00747.

The International Polymer Colloid Group (IPCG) was founded in 1972 as a forum for the exchange of ideas and emerging research activities for scientists and engineers from both academia and industry who study or use polymer colloids. This special issue of *Biomacromolecules* highlights some of the research from IPCG members. We currently have over 130 members from academia, industry, and government research organizations representing over two dozen countries. Activities include a biennial International Polymer Colloid Group Research Conference and a semiannual newsletter that includes a summary of recent (including unpublished) research results from members. Industrial participation remains a cornerstone of the IPCG, based on our belief that research collaborations lead to greater opportunities for research results to translate into commercial implementation and

impactful societal benefit. One quarter of our members come from industry and our conferences feature strong industrial representation in the lectures.

In 2020, we published our first IPCG Special Issue in *Biomacromolecules* ("Polymer Colloids: Synthesis Fundamentals to Applications"). In that issue we included three Reviews describing various aspects of the fundamental principles of polymer colloid synthesis (10.1021/acs.biomac.0c00769; 10.1021/acs.biomac.0c00549; 10.1021/acs.biomac.0c00558). In particular, the Review by Professors Peter Lovell and Joseph Schork on the Fundamentals of Emulsion Polymerization (10.1021/acs.biomac.0c00769) has close to 100000 downloads. This Review highlighted the mechanistic complexity of emulsion polymerization, providing a fundamental basis to create new and interesting polymer colloids for many applications. Some impactful scientific discoveries from IPCG members to the research community using such fundamental insights include the implementation and use of PISA (10.1021/ja502843f) and the TDMT (10.1021/acsnano.4c14506) methods. Both methods are finding many applications in bioapplications, for example, in drug and vaccine delivery, stem cell expansion, and antiviral coatings.

In previous decades, most polymer colloid research was targeted at fields such as coatings, sealants, adhesives, fuel modifiers and rubber, all derived from petroleum or natural gas sources. While those areas remain important, we are now witnessing a significant transition to macromolecules that are biosourced, contain biological moieties, or are designed for biomedical applications. Developing more sustainable polymers and processes is a key motivator for both academic and industrial research, and emulsion polymerization (the most common process used to make polymer colloids) enjoys the advantages of an environmentally benign reaction medium (water), high polymerization rates due to compartmentalization of the growing polymeric radicals, easily tuned chemical functionality, and scalability (10.1021/acsnano.4c14506). Incorporating reversible-deactivation radical polymerization chemistry further enables the precise control over microstructure and particle morphology.

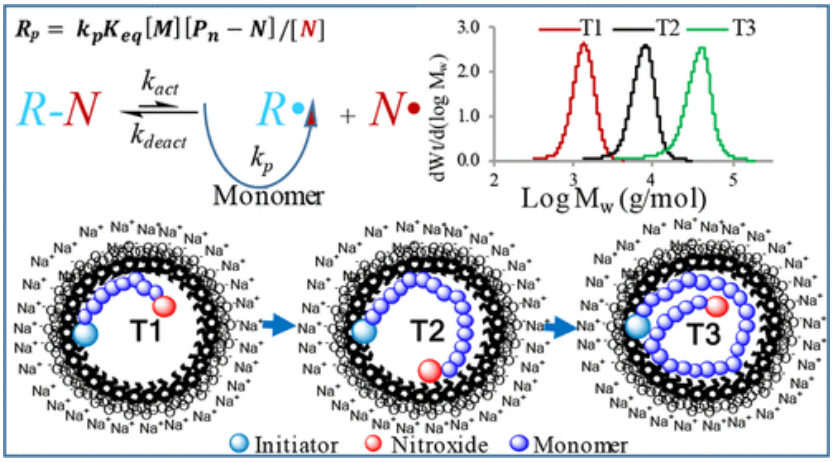
In this issue, we have focused on research manuscripts. Readers interested in better understanding the underlying principles of polymer colloid synthesis are referred to those reviews. Perusal of the first special issue and this new issue quickly reveal how rapidly research interest and priorities in the field of polymer colloids is evolving toward biomacromolecules. The two coeditors of both IPCG special issues (MJM, MFC) have been involved in polymer colloid research for over 35 years, and have been actively involved in the changing face of the field's scope and increasing prominence in the study of biomacromolecules.

This special issue features 20 contributions spanning diverse topics including biomedical applications
(10.1021/acs.biomac.4c00317; 10.1021/acs.biomac.4c00431; 10.1021/acs.biomac.4c00645 ; 10.1021/acs.biomac.4c00415; 10.1021/acs.biomac.4c00605; 10.1021/acs.biomac.4c0090 1; 10.1021/acs.biomac.4c00753), biobased monomers
(10.1021/acs.biomac.4c00128; 10.1021/acs.biomac.4c00739; 10.1021/acs.biomac.4c00742 ; 10.1021/acs.biomac.4c01444), synthetic/natural polymer hybrids
(10.1021/acs.biomac.4c00138; 10.1021/acs.biomac.4c00744; 10.1021/acs.biomac.4c01279 ; 10.1021/acs.biomac.4c01802) and biodegradeable polymers

(10.1021/acs.biomac.4c00417), as well as fundamental emulsion polymerization and polymer colloid synthesis (10.1021/acs.biomac.4c00412; 10.1021/acs.biomac.4c00292; 10.1021/acs.biomac.4c00728 ; 10.1021/acs.biomac.4c00815).
With this special issue, our intent is to further foster mutual understanding between the biomacromolecules and polymer colloid communities of the expertise each community has developed. We hope everyone enjoys this special issue and welcome feedback. If you have an interest in IPCG, including becoming a member, please contact either of us.

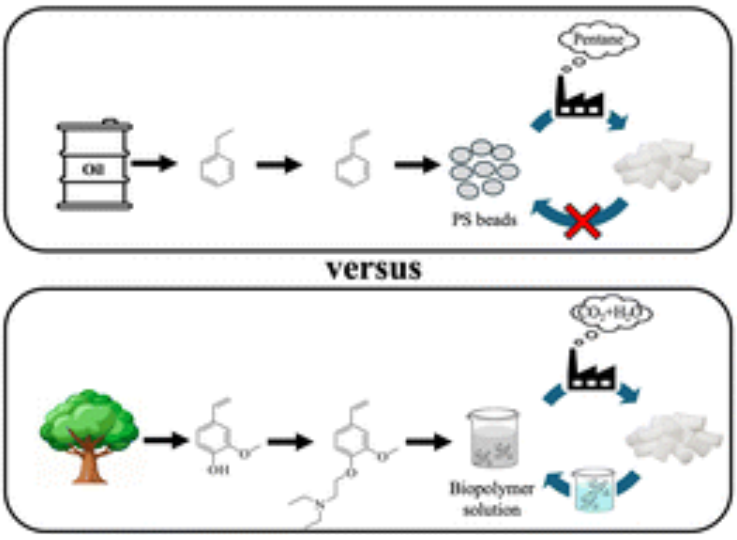
7. González-Blanco, R., Cunningham, M. F., & Saldívar-Guerra, E. (2025). Semibatch emulsion polymerization using TIPNO and the Universal Alkoxyamine. *Industrial & Engineering Chemistry Research*, *64*(36), 17601–17613. https://doi.org/10.1021/acs.iecr.5c02453

Abstract: Three bicomponent initiation systems, consisting of 2,5-trimethyl-4-phenyl-3-azahexane-3-nitroxide (TIPNO) and one of the initiators potassium persulfate (KPS), benzoyl peroxide (BPO), or 2,2'-azobis(isobutyronitrile) (AIBN), were used to develop a robust and versatile semibatch emulsion polymerization process to obtain polystyrene (PS) latexes with solids up to 40 wt % . The alkoxyamine of TIPNO was also used as a macroinitiator to prepare stable and controlled latexes of PS, poly(n-butyl methacrylate) (PnBMA), poly(n-butyl acrylate) (PnBA), poly(2-ethylhexyl acrylate) (PEHA), and the copolymer PS-b-PnBA with solids contents up to nearly 40 wt %. Using different concentrations of styrene (St) in the nucleation step and by varying the monomer feed rate, it was possible to obtain colloidal dispersions with particle sizes ranging from similar to 80 to similar to 300 nm, conversions up to similar to 97.0%, nitroxide efficiencies (N Eff) up to similar to 1.00 and number-average molecular weights (M n) from similar to 46,000 to similar to 102,000 g/mol. These polymerizations were conducted using a simple and rapid process, similar to industrially used conditions, as the seed is formed in situ during the heating ramp and the initial stage of the polymerization.



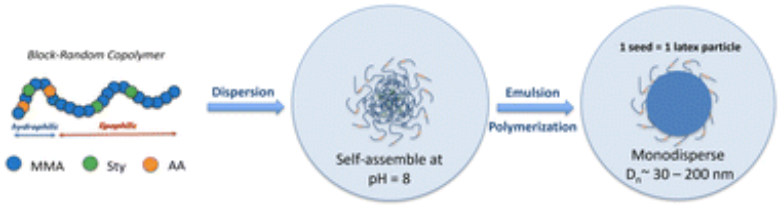
8. Barker, Daniel, Michael F. Cunningham, Guojun Liu, and Philip G. Jessop. "Expanding and Recycling a Water-Resistant Bioderived Rigid Foam Using CO2 - Responsive Amines and Carbonated Water." *Green Chemistry* 27, no. 42 (2025): 13331–48. https://doi.org/10.1039/d4gc06165a.

Abstract: Rigid foams such as expanded polystyrene (EPS) packing have become common when transporting or storing valuable items. EPS is an inexpensive, lightweight, and robust protective material that can be easily moulded into a desired shape. Economically, EPS is an excellent choice for packaging; however, it puts a significant strain on the environment. It is made from petrochemicals, uses smog-forming organic solvents as blowing agents, and is rarely recycled because it is expensive to recycle. Biobased foams have been developed to try and mitigate the environmental impacts of EPS production and end-of-life but have poor water resistance during use, which is a key feature in packaging. We have developed a rigid foam material from vanillin that addresses the environmental issues of EPS and the lack of water resistance of current biobased foams. Adding a tertiary amine group to a vanillin-derived polymer made it possible for the polymer to be CO_2-responsive, as polymers containing tertiary amines can alter their properties in the presence or absence of CO_2 and water. This CO_2-responsive feature allowed the polymer to be hydrophobic during use but dissolve in carbonated water at the end of life. The dissolved polymer in carbonated water can be re-expanded back into a foam by rapid heating, which allows the polymer to have improved recyclability compared to EPS and avoid organic solvent blowing agents. This bioderived CO_2-responsive rigid foam can be recycled back into new rigid foam materials with a 98% material recovery efficiency. Recycling had an impact on the foam mechanical properties but the foam maintained water resistance even after 5 recycling cycles. A bioderived CO_2-responsive rigid foam such as this may, after further development, be a greener substitute for EPS packing materials.



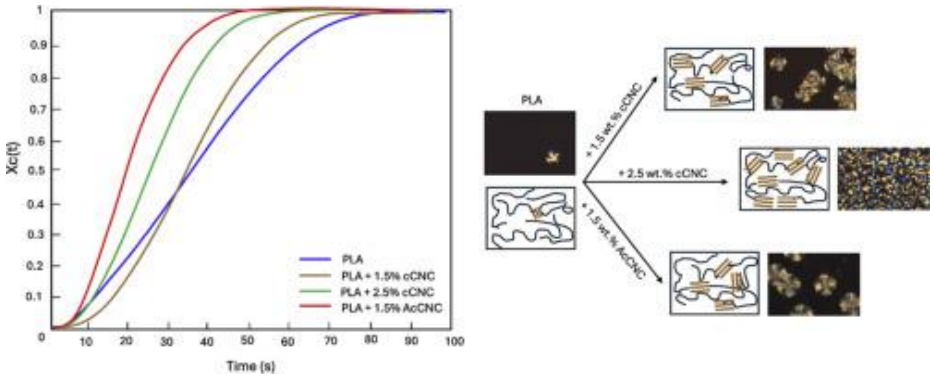
9. Werner, A., Sanders, C. A., Smeltzer, S. E., & Cunningham, M. F. (2025). Emulsion polymerisation stabilised by block-random copolymers: ultra-small particles at low stabiliser levels. *Polymer Chemistry*, *16*(43), 4705–4708. https://doi.org/10.1039/d5py00884k

Abstract: Poly(methyl methacrylate)-*b*-poly(methyl methacrylate-*r*-acrylic acid) block-random copolymers were used as stabilisers in the semi-batch emulsion polymerisation of methyl methacrylate (MMA). By adjusting the pH, nano-latexes with particle sizes ~30–200 nm were obtained using a surprisingly low stabiliser content (~0.01 wt% based on monomer).



10. Werner, A., Sanders, C. A., Smeltzer, S. E., & Cunningham, M. F. (2025). Emulsion polymerisation stabilised by block-random copolymers: ultra-small particles at low stabiliser levels. *Polymer Chemistry*, *16*(43), 4705–4708. https://doi.org/10.1039/d5py00884k

Abstract: Polylactic acid (PLA) has garnered increasing attention as a biodegradable polymer derived from renewable resources; however, its relatively slow crystallization rate restricts its broader use in wider applications. We address this challenge by producing PLA nanocomposites with carboxylated cellulose nanocrystals (cCNCs) and acetylated cCNCs (AcCNCs) in ethyl lactate (EtLa), a bio-based, non-toxic solvent. The crystallization behavior and thermomechanical properties of the nanocomposites were measured using X-ray diffraction (XRD), differential scanning calorimetry (DSC), thermogravimetric analysis (TGA), dynamic mechanical analysis (DMA), and polarized light microscopy (PLM). For PLA-cCNC nanocomposites, Avrami analysis confirmed a transition from two- to three-dimensional spherulitic growth. The addition of cCNCs or AcCNCs with a low degree of substitution (i.e., DS = 0.06) in PLA led to increased crystallization rates. This demonstrated that the cCNCs and AcCNCs enhanced heterogeneous nucleation and the use of EtLa enhanced PLA chain mobility. XRD measurements revealed an increase in average crystallite size when cCNCs and AcCNCs were added to the PLA, signifying improved crystal development. Although both cCNCs and AcCNCs promoted PLA crystallization, the nucleating efficiency of AcCNCs was hampered by reduced compatibility with the EtLa solvent, likely leading to some AcCNC aggregation. The results show how leveraging a greener solvent (EtLa) and utilizing cCNCs can effectively address PLA crystallization limitations, thereby expanding opportunities to enhance high-performance, sustainable materials in packaging, additive manufacturing, and biomedical engineering.



11. Korchinsky, R. S., Brito, J. G. L., Fieldhouse, L., Champagne, P., Cunningham, M. F., & Jessop, P. G. (2025). Forward osmosis followed by reverse osmosis for the removal of contaminants of emerging concern using a CO2-responsive draw agent. *Journal of Hazardous Materials*, *500*, 140368. https://doi.org/10.1016/j.jhazmat.2025.140368

Abstract: Contaminants of Emerging Concern (CECs) are unmonitored and unregulated chemicals in the environment that cause adverse effects on human and environmental health. This study used forward osmosis followed by reverse osmosis (FO-RO) to remove CECs from water using a CO_2-responsive draw agent. Such agents, when dissolved in water, exhibit a high osmotic pressure (π) when exposed to an atmosphere of CO_2, yet a low π once the CO_2 is removed. The high π is the driving force that pulls water across the membrane during the FO step, after which a low π makes it easy to separate the permeate from the draw agent by RO. An artificial solution containing six common CECs was investigated: ciprofloxacin, atenolol, trimethoprim, sulfamethoxazole, acetaminophen, and carbamazepine. Over multiple filtration cycles, the removal efficiencies ranged from 90 to > 99 %, demonstrating that FORO using a CO_2-responsive draw agent is an effective filtration method for removing CECs from an aqueous solution.