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Educational Background

Pennsylvania State University, Chemical Engineering, B.S. (with honors/high distinction)	1983
University of California at Berkeley, Chemical Engineering, Ph.D. (M.C. Williams, advisor)	1988
University of Cambridge, Materials Science & Metallurgy, Research Scholar (A.H. Windle)	1988-89
Institute for Energy Technology, Soft Condensed-Matter Physics, Research Fellow (T. Riste)	1989

Professional Experience

NC State University

2016 – present	Distinguished Professor of Chemical & Biomolecular Engineering
2015 – present	Alumni Distinguished Graduate Professor
2002 – 2016	Professor of Chemical & Biomolecular Engineering
2002 – present	Professor of Materials Science & Engineering
2001 – present	Alumni Distinguished Undergraduate Professor
1997 – 2002	Associate Professor of Materials Science & Engineering and Chemical Engineering
1992 – 1997	Assistant Professor of Materials Science & Engineering
2021	Visiting Scholar, Kraton Corporation, Houston, TX
2018	Visiting Professor, University of Warsaw, Warsaw (Poland)
2017-2019	Visiting Professor, Adam Mickiewicz University, Poznan (Poland)
2017	Erudite Professor, Mahatma Gandhi University, Kerala (India)
2017	Visiting Professor, Humboldt University, Berlin (Germany)
2012	Lars Onsager Professor, Norwegian University of Sci. & Technol., Trondheim (Norway)
2007	Tewkesbury Fellow, University of Melbourne, Melbourne (Australia)
2005	Visiting Scientist, Los Alamos National Laboratory, Los Alamos, NM
1999	Visiting Professor, Kyoto University, Kyoto (Japan)
1998, 2000	Alexander von Humboldt Research Fellow, Freiburg University, Freiburg I.Br. (Germany)

Prior to NC State University

1990 – 1992	Staff Scientist, Corporate Research Division, Procter & Gamble Co., Cincinnati, OH
1989	Research Fellow, Institutt for Energiteknikk, Kjeller (Norway)
1988 – 1989	Research Scholar, University of Cambridge, Cambridge (United Kingdom)
1983 – 1988	Graduate Student Research Assistant, Lawrence Berkeley Laboratory, Berkeley, CA

Awards & Honors

(Inter)National Awards/Honors while at NC State University (H.S. = Honor Society)

Walston Chubb Award for Innovation	2025
Hollomon Award for Materials and Society	2025
Distinguished Lectureship	2025
Pillar of Leadership Award in Academics & Research	2025
Elected Fellow	2025
Medal for Excellence	2024
ChemLuminary Award (NC-ACS Senior Chemists)	2024
Honorary doctorate (*doctor honoris causa*) degree	2024
Jefferson Science Fellowship [*declined*]	2023
Underwood Medal	2023
McDonald Mentor Award	2023
Roy W. Tess Award in Coatings	2022
Global Awards Winner [Research Project]	2022
SPSJ International Award	2022
Elected Fellow	2022
Innovative Idea of the Year Award	2022
Distinguished Alumnus Award	2021
Sigma Xi Scientific Research H.S.	2025
Acta Materialia, Inc.	2025
Sigma Xi Scientific Research H.S.	2025
Omicron Delta Kappa Leadership H.S.	2025
Society of Plastics Engineers	2025
Inst. of Mater., Minerals & Mining (UK)	2024
American Chemical Society	2024
Norwegian University Sci. and Technol.	2024
U.S. National Academies	2023
Institution of Chemical Engineers (UK)	2023
Tau Beta Pi Engineering H.S.	2023
American Chemical Society (PMSE)	2022
Institution of Chemical Engineers (UK)	2022
Society of Polymer Science (Japan)	2022
American Chemical Society (PMSE)	2022
Waterloo Filtration Institute (Canada)	2022
Tau Beta Pi Engineering H.S.	2021

Global Award Highly Commended Entry [Res. Project]	Institution of Chemical Engineers (UK)	2021,24
Global Award Highly Commended Entry [Pharma]	Institution of Chemical Engineers (UK)	2019-21
International Award	Society of Plastics Engineers	2015
Elected Member	Norwegian Academy of Technol. Sci.	2015
Elected Fellow	Royal Society of Chemistry (UK)	2015
Fulbright Senior Specialist Award	IIE CIES[1]	2014
Lars Onsager Professorship and Medal	Norwegian University Sci. and Technol.	2012
Alumni Fellow Award	Pennsylvania State University	2012
Colwyn Medal	Inst. of Mater., Minerals & Mining (UK)	2011
Elected Fellow	Inst. of Mater., Minerals & Mining (UK)	2011
Chemistry of Thermoplastic Elastomers Award	American Chemical Society (Rubber)	2008
Elected Fellow	American Physical Society	2008
Ernst Ruska Prize	German Electron Microscopy Society	2007
Cooperative Research Award in Polymer Science	American Chemical Society (PMSE)	2006

Awards/Honors from NC State University

Outstanding Extension Award	University-level	2025
Jackson Rigney International Service Award	University-level	2024
Alexander Quarles Holladay Medal for Excellence	University-level (highest faculty award)	2022
R.J. Reynolds Tobacco Co. Award for Excellence[2]	College of Engineering (highest award)	2022
Elected Member	Global Engagement Academy	2019
Elected Member	Research Leadership Academy	2019
Outstanding Global Engagement Award	University-level	2018
Alcoa Distinguished Engineering Research Award	College of Engineering	2012
Board of Governors' Award for Excellence in Teaching	University-level (highest UNC[3] award)	2008
Outstanding Research Award	Alumni Association	2005
George H. Blessis Outstanding Advisor Award	College of Engineering	2003
Outstanding Teaching Award	Alumni Association	2000
Inducted Member	Academy of Outstanding Teachers	2000
Alcoa Foundation Research Achievement Award	College of Engineering	1996
Outstanding Research Achievement Award	*Sigma Xi* Scientific Research H.S.	1995

Miscellaneous Awards/Honors while at NC State University

Global Award Finalist [Research Project / Pharma]	Institution of Chemical Engineers (UK)	2018-22,24
Outstanding Alumnus Award	Penn State Univ. Schuylkill Campus	2017
Outstanding Mid-Career Teaching Award	Am. Soc. Eng. Ed. (Southeast Region)	2009
Outstanding Scholar Alumnus Award	Penn State Univ. Schreyer College	2007

Procter & Gamble Company

Team Achievement Award	Corporate Research Division	1992

Institute for Energy Technology

Research Fellowship	Royal Norwegian Council	1989

University of Cambridge

Edward Emley Award	Institute of Metals	1989
Visiting Associateship (extended to Life Membership)	Clare Hall	1988

University of California at Berkeley

Distinguished Scholar Award	Microbeam Analysis Society	1987
Presidential Award	Electron Microscopy Soc. of America	1986
Outstanding Teaching Assistant Award	Department of Chemical Engineering	1985

[1] Institute of International Education Council for the International Exchange of Scholars
[2] In teaching, research and extension ($25,000 prize).
[3] University of North Carolina system.

Pennsylvania State University

University Scholars Medal (inaugural year)		Schreyer Honors College	1983
Inducted Member		*Phi Kappa Phi* Honor Society	1982
Inducted Member		Golden Key Honor Society	1982
Inducted Member		*Phi Lambda Upsilon* Chem. Honor Soc.	1982
Inducted Member		*Omicron Delta Kappa* Leader. Hon. Soc.	1982
Inducted Member		*Tau Beta Pi* Engineering Honor Society	1981
Superior Cadet Medal		Army Reserve Officers Training Corps	1981
Director's Saber Award to Outstanding ROTC Cadet		Schuylkill Campus	1981
Scabbard & Blade Military Honor Society		Army Reserve Officers Training Corps	1981
President's Freshman Scholar Award		University-level	1980

Research Featured on Journal Covers

Macromolecular Rapid Commun.	2021	*J. Colloid Interface Science*	2020
ACS Macro Letters	2018	*Journal of Chemical Physics*	2018
Solar Rapid Research Letters	2018	*Macromolecular Rapid Commun.*	2017
Soft Matter (RSC)	2017	*Proc. Royal Microscopy Society*	2017
J. Polymer Science B: Polymer Physics	2017	*J. Polymer Science B: Polymer Physics*	2017
Macromolecular Rapid Commun.	2016	*Macromolecular Rapid Commun.*	2015
Macromolecular Rapid Commun.	2012	*Langmuir* (ACS)	2011
J. Polymer Science B: Polymer Physics	2011	*Macromolecules* (ACS)	2010
Polymer	2009	*Advanced Materials*	2007
Materials Research Society Bulletin	2006	*Macromolecular Rapid Commun.*	2006
Langmuir (ACS)	2004	*Macromolecular Chemistry & Physics*	2004
Macromolecular Chemistry & Physics	2003	*Advanced Materials*	2003
Macromolecular Rapid Commun.	2002	*Macromolecular Materials & Eng.*	2000
Microscopy Today	1999	*Langmuir* (ACS)	1997
Journal of Materials Science	1996	*Langmuir* (ACS)	1996
Langmuir (ACS)	1995	*Microscopy Research & Technique*	1994

Research results featured on book *Developments in Block Copolymer Science & Technology* 2004

Professional Memberships

Alpha Chi Sigma Professional Chemistry Fraternity 1984-
- Vice-Master Alchemist (1987)

American Chemical Society 1982-
- Chairman (1995-96), Chairman-elect (1994-95) — North Carolina Polymer Discussion Group
- Senior Chemist Co-chair (2018-23); Alternate Councilor (2024-) — North Carolina Section
- Director (2021-23) — Blue Ridge Rubber Group (sitting on national Executive Board)
- Executive Committee (2023-) — PMSE Division

Tau Beta Pi Engineering Honor Society 1981-
- Student Chapter Advisor (2003-04, 2019-); Director, RTP Professional Chapter (2020-22)
- President, RTP Professional Chapter (2023-)

American Physical Society 1991-06

Institute of Materials, Minerals and Mining 2011-

Materials Research Society 1990-14, 2018-
- President (1996), Secretary (1995) — North Carolina Section
- Inaugural Student Chapter Advisor (1998-2000)

Microscopy Society of America 1986-96
- National Program Committee (1992-94)

Royal Society of Chemistry 2014-

Society of Plastics Engineers 2010-
- Student Chapter Advisor (2013-)
- Executive Board Member — Piedmont Coastal Professional Chapter (2022-23)
- Board of Directors — Thermoplastic Elastomer Technical Interest Group (2024-)

American Association for the Advancement of Science 2017-

Fulbright Association North Carolina Chapter (Board of Directors) 2023-

Overview of Research Achievements (primary themes could overlap)

Healthcare

- Produced inherently broad-spectrum antimicrobial polymers that could kill >99.99% of MRSA, *C. difficile*, Ebola, and SARS-CoV-2, as well as other bacteria, viruses and fungi, in 5 min or less.
- Developed broad-spectrum antimicrobial polymer films and coatings with photosensitive dyes that could continuously kill bacteria, viruses and fungi in the presence of oxygen and visible light.
- Fabricated a unique class of strain-reversible piezoresistive polymer nanocomposites from conventional or thermoplastic elastomers with carbon nanofiber for wearable and textile sensors.

Environment

- Processed novel carbon-capture membranes nanofabricated as surface-aminated polymeric materials with record-shattering CO_2/N_2 selectivity ($>10^3$) *and* CO_2 permeability ($>10^3$ Barrer).
- Established that chemically-crosslinked polyether-based polymer and nanocomposite membranes are CO_2-selective and highly effective for carbon capture and hydrogen purification.
- Used charged thermoplastic elastomers in the presence of an ionic liquid or after hydrothermal treatment to generate highly basic- (NH_3) or acidic- (CO_2) permeable gas-separation membranes.
- Introduced nonporous nanoparticles into glassy polymers to frustrate chain packing and make the membranes reverse-selective, allowing larger gas molecules to permeate faster than small ones.
- Produced a variety of new biopolymer systems (relying on nanocellulose or chemically-modified additives) that exhibit greatly enhanced mechanical properties while remaining degradable.

Energy

- Created precisely tunable soft materials from thermoplastic elastomers for use in a wide range of applications, including electroresponsive technologies such as soft actuators and robotics.
- Developed new materials for use as ultrahigh-strain, self-supported dielectric elastomers and relaxation-free ionic polymer-metal composites that exceed the property limits of other materials.
- Processed high-efficiency composite dielectric elastomers that exhibit anisotropic electroactuation by either incorporating fibrous scaffolds or subjecting crystals present to mechanical orientation.
- Fabricated both photosynthetic solar cells that mimic plants and dye-sensitized solar cells with up to 7% efficiency from charged thermoplastic elastomers imbibed with different Ru-based dyes.
- Used a charged thermoplastic elastomer to produce long-life water-in-salt electrolyte (WiSE) Li-ion batteries that charge faster than conventional batteries and remain safer for consumer use.
- Found that a charged thermoplastic elastomer could serve as an anion-exchange layer in bipolar membrane electrolyzers that operate near the reversible water-dissociation limit to generate H_2.

Fundamental and Applied Soft Materials Science & Engineering

- Pioneered transmission electron microtomography (TEMT) as a highly valuable characterization tool for obtaining/quantifying 3-D images of complex nanostructures in soft materials science.
- Reported the first real-space 3D bicontinuous nanostructure of ordered block polymers and included quantitative measurements never before performed (*e.g.*, local curvature and genus).
- Pioneered a new characterization technique to identify the onset of a lyotropic phase transition on the basis of isothermal calorimetry (ITC) in a matter of minutes/hours instead of days/weeks.
- Reported the first benefit of polarization near-field scanning optical microscopy (PNSOM) for studying the ordered structure of semi-crystalline polymer fibers at ultrahigh spatial resolution.
- Developed a variety of new designer block copolymer systems (including gels) with controllable structures and properties for an improved fundamental understanding of molecular self-assembly.
- Combined experimental and computational efforts to optimize both the cure kinetics and property development of tough multicomponent polymer coatings applied on various consumer products.
- Introduced functionalized (in)organic nanoparticles in different polymer systems for antireflective surfaces, *in vivo* bioimaging, double-percolated conductivity, and reversible surface patterning.
- Demonstrated the mechanism by which charged thermoplastic elastomers self-assemble and how their morphologies can be solvent-templated or altered by solvent-vapor/water annealing.
- Introduced physical and chemical approaches to control the phase behavior of block polymers that self-assemble into soft nanostructures and identified competitive molecular processes.
- Identified the principle of time-composition superpositioning in thermoplastic elastomers that permits rigorous extrapolation of mechanical properties over 10 orders of magnitude in time.
- Improved the chemical understanding of polymer abrasion to mitigate microparticle production.

Research Productivity at a Glance (as of March 30, 2025)

Number of publications:

	Peer-reviewed journal publications	Book chapters, invited works*
In review	3	0
In press	1	0
Published	318 (277 at NC State)	40

*does not include proceedings

Number of peer-reviewed publications in journals with an impact factor of at least 10: 40

Number of peer-reviewed publications co-authored with a graduate student: 228
Number of peer-reviewed publications co-authored with an undergraduate student: 45
(only students from NC State are considered in these compilations)

Number of peer-reviewed publications with at least 1000 citations (Google Scholar): 1
Number of peer-reviewed publications with at least 200 citations (Google Scholar): 13
Number of peer-reviewed publications with at least 100 citations (Google Scholar): 46

Publication metrics:

	h-index	Number of citations
Google Scholar	67	17,285
ISI Web of Science	56	12,219

Number of patents:

Pending	6
Published	6
Issued	6

Number of invited presentations delivered: 426

Award lectures	19		
Plenary	30		
Keynote	37		
Generally invited (including above)	212 (universities)	66 (industries/nat'l labs)	148 (conferences)
Contributed	99		
International (excluding virtual)	202 invited (23 contributed)		

Number and type of research news releases:

University press releases	9 (excluding departmental announcements)
External press releases	2
Journal/magazine announcements	20 (excluding websites)
TV or radio interviews	4 (3 on antimicrobial polymers and 1 on CO_2 membranes)

Sources of project support:

Federal or state government	19
Private industry	38
Societal foundations	2
University centers/institutes	17

Student development:

Post-docs (current)	0
Post-docs (previous)	9
Ph.D. students (current)	4 (+1 international co-advised Ph.D. student)
Ph.D. students (graduated)	40 (+3 international co-advised Ph.D. students)
M.S. students (current)	0
M.S. students (graduated)	18
Undergraduate researchers (total)	>130
High-school researchers (total)	2

Research Productivity

Peer-reviewed Journal Publications

In preparation (submission planned by July 31, 2025; titles are tentative)

325. Michel, R., Yan, J., Jansson, A., Braunfeld, M.B., Keszthelyi, B., Zheng, S.Q., Weikl, T., Gradzielski, M., and Spontak, R.J., "3D Cryoelectron Tomography of Nanoparticle Insertion into Multilamellar Microvesicles ," *Phys. Rev. Lett*., in preparation.

324. Shamsi, M., Shakoury, N., Yan, J., Dickey, M.D., and Spontak, R.J., "Structure-Property Relationships in Meltblown Microfibers Composed of Chemically-Dissimilar Thermoplastic Elastomer Blends," *ACS Appl. Polym. Mater.*, in preparation.

323. Woloszczuk, S., Yan, J., Gavrilov, A., Xie, J., Rumyantsev, A., Shi, A.-C., Banaszak, M., Floudas, G., and Spontak, R.J., "The Structure-Property Transition from Rubber-Toughened to Thermoplastic Elastomeric Behavior," *Nature*, in preparation.

Under review

322. Wells, K.M., McFeaters, F.E., Fisher, E.M., Schulle, F., Ghiladi, R.A., and Spontak, R.J., "Rapid, Effective, Comprehensive, and Continuous Antimicrobial Polymer Surfaces that Require No Additives and Avoid AMR," *Mater. Horiz*. (invited), submitted.

321. Wells, K.M., Silva-Ayala, D., Dejarnette, S.J., Faircloth, J.P., O'Reilly, P., Ghiladi, R.A., Jaykus, L.-A., Schulle, F., Spontak, R.J., and Griffiths, A., "Rapid Inactivation Kinetics of a Broad Range of Viruses on a Continuously Self-Cleaning Polymer Surface," *New. Engl. J. Med.*, submitted.

320. Wells, K.M., Ghiladi, R.A., and Spontak, R.J., "On the Use of Film Thickness to Control the Fast-Acting Antimicrobial Mechanism Afforded by an Anionic Block Polymer," *Adv. Sci.*, submitted.

In press

In print

319. Wei, J., Ma, Y., Qin, Z., Deng, J., Selyanchyn, R., Li, N., Fan, L., Li, Z., Deng, L., Yi, S., Spontak, R.J., and Dai, Z., "Inconsistent Gas-Separation Results for Pebax Carbon-Capture Membranes: The Need for Standardized Analysis," *Polym. Rev*. (invited), **65**, 623 (2025).

318. Terán, J.E., Pal, L., Spontak, R.J., and Lucia, L., "Chemical Analyses of Thermoplastic Surface Abrasion: Beyond the Scratches from a Mechanochemistry Perspective," *Appl. Surf. Sci.*, **697**, 162898 (2025).

317. Shamsi, M., Tantorno, B., Dickey, M.D., and Spontak, R.J., "Multicomponent Shape-Memory Nonwoven Microfiber Mats with Precisely Tunable Thermal Triggers," *Colloids Surf. A*, **711**, 136382 (2025).

316. Sasmal, S., Chen, L., Sarma, P., Traenkle, O., Simons, C.R., Wells, K.M., Spontak, R.J., and Boettcher, S.W., "Materials Descriptors for Advanced Water Dissociation Catalysts in Bipolar Membranes," *Nat. Mater*., **23**, 1421 (2024).

315. McFeaters, F.E. and Spontak, R.J., "Fundamental Principles and Emerging Opportunities for Selectively-Solvated Block Copolymer Networks in Nonpolar Media: A Perspective," *Adv. Phys. Res*. (invited), **3**, 2400027 (2024).

314. Shamsi, M., Wells, K.M., Yan, J., Dickey, M.D., and Spontak, R.J., "Thermoplastic Elastomers and

Their Gels Electrospun into Tunable Microfibrous Nonwovens: Nanostructure Formation and Property Enhancement," *Adv. Funct. Mater.*, **34**, 2314013 (2024).

313. Hames, N.T., Balsbough, A., Yan, J., Wu, S., Zuo, X., and Spontak, R.J., "Midblock-Solvated Thermoplastic Elastomers from Triblock Copolymers with Crystallizable Endblocks," *Mater. Horiz.*, **10**, 4968 (2023).

312. Jin, S.-A. and Spontak, R.J., "Fundamentals of and Advances in Nanocellulose and Nanochitin Systems," *Adv. Ind. Eng. Polym. Res.*, **6**, 356 (2023).

311. Wei, J., Deng, J., Ma, Y., Guo, H., Wang, B., Deng, L., Spontak, R.J., and Dai, Z., "High-Performance Carbon-Capture Membranes Developed by (Non)Solvent-Induced Nanostructural Rearrangement in Nafion," *J. Mater. Chem. A*, **11**, 18146 (2023),

310. Wells, K.M., Ciftci, Y., Peddinti, B.S.T., Ghiladi, R.A., Vediyappan, G., Spontak, R.J., and Govind, R., "Preventing the Spread of Life-Threatening Gastrointestinal Microbes on the Surface of a Continuously Self-Disinfecting Block Polymer," *J. Colloid Interface Sci.*, **652**, 718 (2023).

309. Yang, J., Germack, D.S., and Spontak, R.J., "Characterization of Controlled-Distribution Hydrogenated Styrenic Block Copolymers by NMR Spectroscopy," *ACS Appl. Polym. Mater.*, **5**, 6003 (2023).

308. Wells, K.M., Miller, M.M., Ghiladi, R.A., and Spontak, R.J., "Fast Bacterial Inactivation Kinetics on the Surface of an Inherently Antimicrobial Anionic Block Polymer," *ACS Appl. Eng. Mater.*, **1**, 467 (2023).

307. Dai, Z., Guo, H., Deng, J., Deng, L., Yan, J., and Spontak, R.J., "Carbon Molecular-Sieve Membranes Developed from a Tröger's Base Polymer and Possessing Superior Gas-Separation Performance," *J. Membr. Sci.*, **680**, 121731 (2023).

306. Terán, J.E., Pal, L., Spontak, R.J., and Lucia, L., "Surface Mechanical Properties and Topological Characteristics of Thermoplastic Copolyesters after Precisely Controlled Abrasion," *ACS Appl. Mater. Interfaces*, **15**, 7552 (2023).

305. Sandru, M., Sandru, E.M., Stenstad, P.M, Ingram, W.F., Deng, J., Deng, L., and Spontak, R.J., "An Integrated Materials Approach to Ultrapermeable and Ultraselective CO_2 Polymer Membranes," *Science*, **376**, 90 (2022).

304. Jin, S.-A., Khan, S.A., Spontak, R.J., and Rojas, O.J., "Anion-Specific Water Interactions with Nanochitin: Donnan and Osmotic Pressure Effects as Revealed by Quartz Microgravimetry," *Langmuir*, **37**, 11242 (2021).

303. Yan, J., Lee, B., Smith, S.D., and Spontak, R.J., "Morphological Studies of Solution-Crystallized Thermoplastic Elastomers with Polyethylene Endblocks and a Random-Copolymer Midblock," *Macromol. Rapid Commun.*, **42**, 2100442 (2021).

302. Ghareeb, C.R., Peddinti, B.S.T., Kisthardt, S.C., Scholle, F., Spontak, R.J., and Ghiladi, R.A., "Towards Universal Photodynamic Coatings for Infection Control," *Front. Med*. (invited), **8**, 657837 (2021).

301. Jin, S.-A., Facchine, E.G., Khan, S.A., Rojas, O.J., and Spontak, R.J., "Mesophase Characteristics of Cellulose Nanocrystal Films Prepared from Electrolyte Suspensions," *J. Colloid Interface Sci.*, **599**, 207 (2021).

300. Jin, S.-A., Facchine, E.G., Rojas, O.J., Khan, S.A., and Spontak, R.J., "Cellulose Nanofibers and the Film-Formation Dilemma: Drying Temperature and Tunable Optical, Mechanical and Wetting Properties of Nanocomposite Films Composed of Waterborne Sulfopolyesters," *J. Colloid Interface*

Sci., **598**, 369 (2021).

299. Peddinti, B.S.T., Downs, S.N., Yan, J., Smith, S.D., Ghiladi, R.A., Mhetar, V., Tocchetto, R., Griffiths, A., Scholle, F., and Spontak, R.J., "Rapid and Repetitive Inactivation of SARS-CoV-2 and Human Coronavirus on Self-Disinfecting Anionic Block Polymers," *Adv. Sci.*, **8**, 2003503 (2021).

298. Peddinti, B.S.T., Morales-Gagnon, N., Pourdeyhimi, B., Scholle, F., Spontak, R.J., and Ghiladi, R.A., "Photodynamic Coatings on Polymer Microfibers for Pathogen Inactivation: Effects of Application Method and Composition," *ACS Appl. Mater. Interfaces*, **13**, 155 (2021).

297. Yan, J., Tuhin, M.O., Sadler, J.D., Smith, S.D., Pasquinelli, M.A., and Spontak, R.J., "Network Topology and Stability of Homologous Multiblock Copolymer Physical Gels," *J. Chem. Phys*., **153**, 124904 (2020).

296. Srewaradachpisal, S., Dechwayukul, C., Chatpun, S., Spontak, R.J., and Thongruang, W., "Optimization of the Rubber Formulation in Footwear Applications from the Response Surface Method," *Polymers*, **12**, 2032 (2020).

295. Facchine, E.G., Jin, S.-A., Spontak, R.J., Rojas, O. J., and Khan, S.A., "Quantitative Calorimetric Studies of the Chiral Nematic Mesophase in Aqueous Cellulose Nanocrystal Suspensions," *Langmuir*, **36**, 10830 (2020).

294. Facchine, E.G., Spontak, R.J., Rojas, O. J., and Khan, S.A., "Shear-Dependent Structures of Flocculated Micro/Nanofibrillated Cellulose (MNFC) in Aqueous Suspensions," *Biomacromol*., **21**, 3561 (2020).

293. Ito, T., Shiota, R., Taniguchi, N., Spontak, R.J., and Nagai, K., "Gas-Separation and Physical Properties of ABA Triblock Copolymers Synthesized from Polyimide and Hydrophilic Adamantane Derivatives," *Polymer*, **202**, 122642 (2020).

292. von Tiedemann, P., Yan, J., Barent, R., Spontak, R.J., Floudas, G., Frey, H., and Register, R.A., "Tapered Multiblock Star Polymers: Synthesis, Selective Hydrogenation, and Properties," *Macromolecules*, **53**, 4422 (2020).

291. Janakiram, S., Ansaloni, L., Jin, S.-A., Yu, X., Dai, Z., Spontak, R.J., and Deng, L., "Humidity-Responsive Molecular Gate-Opening Mechanism for Gas Separation in Ultraselective Nanocellulose/IL Hybrid Membranes," *Green Chem*., **22**, 3546 (2020).

290. Pervaje, A.K., Tilly, J.C., Detwiler, A.T., Spontak, R.J., Khan, S.A., and Santiso, E.E., "Molecular Simulations of Thermoset Polymers Implementing Theoretical Kinetics with Top-Down Coarse-Grained Models," *Macromolecules*, **53**, 2310 (2020).

289. Armstrong, D.P., Chatterjee, K., Ghosh, T.K., and Spontak, R.J., "Form-Stable Phase-Change Elastomer Gels Derived from Thermoplastic Elastomer Copolyesters Swollen with Fatty Acids," *Thermochim. Acta*, **686**, 178566 (2020).

288. Yan, J., Yan, S., Tilly, J.C., Ko, Y., Lee, B., and Spontak, R.J., "Ionic Complexation of Endblock-Sulfonated Thermoplastic Elastomers and Their Physical Gels to Improve Thermomechanical Performance," *J. Colloid Interface Sci.*, **567**, 419 (2020).

287. Corder, R.D., Tilly, J.C., Ingram, W.F., Spontak, R.J., and Khan, S.A., "UV-Curable Nanocomposites Based on Polydimethylsiloxane and Zirconia Nanoparticles: Reactive *vs*. Passive Nanofillers," *ACS Appl. Polym. Mater.*, **2**, 394 (2020).

286. Peddinti, B.S.T., Scholle, F., Vargas, M.G., Smith, S.D., Ghiladi, R.A., and Spontak, R.J., "Inherently Self-Sterilizing Charged Multiblock Polymers that Kill Drug-Resistant Microbes in Minutes," *Mater.*

Horiz., **6**, 2056 (2019). [added to the themed collection of 2019 Materials Horizons Most Popular Articles]

285. Wozniak-Braszak, A., Knitter, M., Markiewicz, E., Ingram, W.F., and Spontak, R.J., "Effect of Composition on the Molecular Dynamics of Biodegradable Isotactic Polypropylene/Thermoplastic Starch Blends," *ACS Sustain. Chem. Eng.*, **7**, 16050 (2019).

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Invited Presentations (including those commitments to the end of March 2025)

428. "Emerging Opportunities for Thermoplastic Elastomers," TechnoBiz Rubber Tech-Talk 2025, virtual, August 2025.

427. "A New Paradigm for Self-Cleaning Antimicrobial Surfaces Promising High Inactivation Efficacy with No Antimicrobial Resistance," 8th International Conference on Materials Science and Nanotechnology," Prague, Czech Republic, 2025 [keynote].

426. "Water-Activated Polymers to Mitigate Growing Global Challenges," Minerals, Metals & Materials Society Annual Spring Meeting, Las Vegas, NV, 2025 [award address].

425. "A New Paradigm for Fast-Acting, Broad-Spectrum, Self-Cleaning Antimicrobial Surfaces Promising High Inactivation Efficacy with No Antimicrobial Resistance, U.S. Army Medical Research Institute of Infectious Diseases, Fort Detrick, Frederick, MD, 2025.

424. "Improving Carbon Capture: Insights from Nanostructured to Hybrid-Integrated Membranes," East Midland Materials Society, virtual, 2025.

423. "ACS Local Section North Carolina Senior Chemists Committee Local Activities" American Chemical Society Leadership Institute, Houston, TX, 2024.

422. "Promising Uses of Carbon Dioxide as an Environmentally-Responsible & Tunable Solvent AFTER Carbon Capture," School of Carbon Neutrality Future Technology, Sichuan University, Chengdu, China, 2024.

421. "Advances in Thermoplastic Elastomers: Bringing Self-Networking Polymers into the 21st Century," Department of Materials, Imperial College, London, UK, 2024.

420. "Advances in Thermoplastic Elastomers: Bringing Self-Networking Polymers into the 21st Century," Department of Materials Science & Engineering, Oxford University, Oxford, UK, 2024.

419. "Improving Carbon Capture: Insights from Nanostructured to Hybrid-Integrated Membranes," Department of Chemistry, University of Birmingham, Birmingham, UK, 2024.

418. "Improving Carbon Capture: Insights from Nanostructured to Hybrid-Integrated Membranes," World Summit and Expo on Polymers and Composite Materials, Rome, Italy, 2024 [plenary].

417. "Polymer Interface and Surface Modification: From Designer Nanolaminates to Chemical Functionalization," Hot Topics in Science and Technology Seminar Series, Department of Chemistry, Lodz University of Technology, Lodz, Poland, 2024.

416. "Directed Block Copolymer Self-Assembly as a Building-Block Route to Novel Hierarchical Superstructures," Stanislaw Ulam Lecture, Department of Chemistry, Adam Mickiewicz University, Poznan, Poland, 2024.

415. "On the Versatility of Charged Thermoplastic Elastomers in the Environment, Energy and Healthcare Sectors," 5th International Conference on Advanced Polymer Science and Engineering, Athens, Greece, 2024 [keynote].

414. "Water-Activated Polymer Designs to Mitigate Growing Global Environmental, Healthcare and Energy Challenges," School of Chemical Engineering, National Technical University of Athens, Athens, Greece, 2024.

413. "Water-Activated Polymers to Mitigate Growing Global Challenges in the Healthcare and Environmental Sectors," 4th International Conference on Materials Science and Nanotechnology, Orlando, FL, 2024 [plenary].

412. "Water-Activated Polymers to Mitigate Growing Global Healthcare and Environmental Challenges," Global Summit on Materials Science and Nanoscience," virtual, 2024 [plenary].

411. "Unique Capability of Anionic Block Polymers as Broad-Spectrum Self-Sterilizing Antimicrobial Surfaces," American Chemistry Society National Meeting, Denver, CO, 2024.

410. "Advances in Nanocellulose: From Analysis to Application," 4th Global Conference on Polymers, Plastics and Composites, Paris, France, 2024 [keynote].

409. "Water-Activated Macromolecules to Mitigate Growing Global Environmental, Healthcare and Energy Challenges," Global Vision Lecture Series, College of Chemical Engineering and Environment, China University of Petroleum, Beijing, China, 2024.

408. "Water-Activated Carbon Capture: From Nanostructured to Hybrid-Integrated Membranes," College of Environment and Resources, Xiangtan University, Xiangtan, China, 2024.

407. "Water-Activated Macromolecules to Mitigate Growing Global Challenges" and ""Directed Self-Assembly of Block Copolymers as a Route to Novel Hierarchical Superstructures," School of Carbon Neutrality Future Technology, Sichuan University, Chengdu, China, 2024.

406. "Water-Activated Carbon Capture: From Nanostructured to Hybrid-Integrated Membranes," 2nd Global Virtual Conference on Climate Change (Climate Conclave 2024), virtual, 2024 [keynote].

405. "Anionic Block Polymers as Next-Generation Broad-Spectrum, Self-Sterilizing Antimicrobial Surfaces," 3rd International Forum on Chemical Engineering and Catalysis, Porto, Portugal, 2024 [plenary].

404. "Combating the Spread of Infectious Diseases with Fast-Acting, Broad-Spectrum, Self-Sterilizing Antimicrobial Polymers," 2nd World Congress on Materials Science & Engineering, London, UK, 2024 [keynote and conference chair].

403. "Water-Activated Materials to Mitigate Growing Global Challenges," Global Meet on Bio-Polymers and

Polymer Science, virtual, 2024 [plenary].

402. "Advances in Thermoplastic Elastomer Gels as a Versatile Class of Functional Soft and Elastic Materials," Tesa SE, Norderstedt, Germany, 2024.

401. "Advances in Thermoplastic Elastomer Gels as a Versatile Class of Functional Soft and Elastic Materials," 3rd International Meet on Condensed Matter Physics, virtual, 2024 [plenary].

400. "Water-Activated Carbon Capture: From Nanostructured to Hybrid-Integrated Membranes," Global Congress on Nanotechnology and Nanomaterials, virtual, 2024 [plenary].

399. "Water-Activated Carbon Capture: From Nanostructured to Hybrid-Integrated Membranes," 2nd International Meet on Polymer Science and Composite Materials, virtual, 2024 [plenary].

398. "Water-Activated Elastomers to Mitigate Growing Global Environmental, Healthcare and Energy Challenges," Institute of Emergent Elastomers, South China University of Technology, Guangzhou, China, 2024

397. "Water-Activated Polymers to Mitigate Growing Global Environmental, Healthcare and Energy Challenges," Norwegian University of Science & Technology, Trondheim, Norway, 2024 [Honorary Doctorate Lecture]

396. "Water-Activated Carbon Capture: From Nanostructured to Hybrid-Integrated Membranes," American Advanced Materials Congress, Miami, FL, 2024 [IAAM Medal Lecture].

395. "Rapid, Broad-Spectrum, Self-Sterilizing Antimicrobial Polymers to Prevent the Spread of Infectious Pathogens," 3rd International Conference on Public Health and Healthcare Management, virtual, 2024 [plenary].

394. "Thermoplastic Elastomer Gels Derived from Controlled-Distribution Triblock Copolymers with Crystallizable Endblocks," 18th ACS-POLY Pacific Polymer Conference, Puerto Vallarta, Mexico, 2023.

393. "Nanoengineered Polymer Membranes for Enhanced Carbon Capture," 18th ACS-POLY Pacific Polymer Conference, Puerto Vallarta, Mexico, 2023.

392. "Polymer Interface and Surface Modification: From Designer Nanolaminates to Chemical Functionalization," Department of Chemical Engineering, University of Valencia, Valencia, Spain, 2023.

391. "Water-Activated Carbon Capture: From Nanostructured to Hybrid-Integrated Membranes," 4th International Conference on Advanced Polymer Science and Engineering, Valencia, Spain, 2023 [keynote].

390. "Advances in Functional Thermoplastic Elastomer Systems as a Versatile Class of Self-Networking Materials," International Conference on Nanotechnology and Materials Science, Barcelona, Spain, 2023 [plenary].

389. "Advances in Functional Thermoplastic Elastomer Systems as a Versatile Class of Self-Networking Materials," International Conference on Nanotechnology and Materials Science, Chicago, IL 2023 [plenary].

388. "Anionic Block Polymers as Next-Generation Broad-Spectrum, Self-Sterilizing Antimicrobial Surfaces," Polymers, Plastics and Composites (PPC2023), Barcelona, Spain, 2023 [keynote].

387. "Advances in Thermoplastic Elastomers: Bringing Self-Networking Polymers into the 21st Century,"

School of Engineering and Materials Science, Queen Mary University London, 2023.

386. "Water-Activated Carbon Capture: From Nanostructured to Hybrid-Integrated Membranes," 3rd Global Summit on Polymer Science and Composite Materials, Lisbon, Portugal, 2023 [plenary and conference chair].

385. "Anionic Block Polymers as Next-Generation Broad-Spectrum, Self-Sterilizing Antimicrobial Surfaces," American Chemistry Society National Meeting, San Francisco, CA, 2023.

384. "Water-Activated Carbon Capture: From Nanostructured to Hybrid-Integrated Membranes," Global Congress on Materials Science and Nanotechnology, London, UK, 2023 [plenary].

383. "Water-Activated Carbon Capture: From Nanostructured to Hybrid-Integrated Membranes," 7th Global Webinar on Materials Science and Engineering, virtual conference, 2023 [plenary].

382. "Water-Activated Carbon Capture: From Nanostructured to Hybrid-Integrated Membranes," Department of Mechatronical Engineering, Beijing Institute of Technology, 2023.

381. "Ultraselective Polymer Membranes for Enhanced Carbon Capture," 2nd Greater Bay Area Symposium on Membranes and Membrane Processes, virtual conference, 2023 [keynote].

380. "Water-Activated Carbon Capture: From Nanostructured to Hybrid-Integrated Membranes," Smart Coatings 2023, virtual conference, 2023.

379. "Anionic Block Polymers as Next-Generation Broad-Spectrum, Self-Sterilizing Antimicrobial Surfaces," Department of Chemistry, Sapienza University of Rome, Rome, Italy, 2023.

378. "Overcoming Antimicrobial Resistance and Preventing the Next Pandemic," TEDxNCState, North Carolina State University, Raleigh, NC, 2023.

377. "Elastomer Design for Medical Applications: Anionic TPEs as Next-Gen Antimicrobials," 8th World Elastomer Summit, Lyon, France, 2023.

376. "Ultraselective Polymer Membranes for Enhanced Carbon Capture," 10th World Congress of Advanced Materials, Sapporo, Japan, 2023 [plenary].

375. "Broad-Spectrum Self-Disinfecting Polymer Surfaces," BioMatForum2023, virtual conference, 2023 [plenary].

374. "Broad-Spectrum Self-Disinfecting Polymer Surfaces: Preparing for Future Health Crises," Thermoplastic Elastomers World Summit, Düsseldorf, Germany, 2022.

373. "Ultraselective Polymer Membranes for Carbon Capture," Waterloo Filtration Institute Annual Conference, virtual conference, 2022 [distinguished lecture].

372. "Ultraselective Polymer Membranes for Economic Carbon Capture: Using Water to Break through the Upper Bound," Department of Materials Science & Metallurgy, University of Cambridge, Cambridge, UK, 2022.

371. "Water-Activated Materials to Mitigate Growing Global Challenges," R.J. Reynolds Tobacco Company Award in Teaching, Research and Extension Lecture, North Carolina State University, 2022 [award lecture].

370. "Broad-Spectrum Self-Disinfecting Polymer Surfaces: Preparing for Future Health Crises," 2nd Global Summit and Expo on Biotechnology and Bioscience, virtual conference, 2022 [plenary].

369. "Surface-Functionalized Polymer Membranes for Ultraselective Carbon Capture," International Conference on Polymer Science and Engineering, virtual conference, 2022 [keynote].

368. "Ultraselective Polymer Membranes for Economic Carbon Capture: Using Water to Break through the Upper Bound," Department of Chemistry, University of Tennessee, Knoxville, TN, 2022.

367. "Broad-Spectrum Self-Disinfecting Antimicrobial Polymer Surfaces," Global Conference on Biomedical Engineering & Systems, virtual conference, 2022 [keynote].

366. "Advances in Thermoplastic Elastomer Gels: Lightweight High-Strain Materials," 10th International Conference and Exhibition on Mechanical & Aerospace Engineering, virtual conference, 2022 [keynote].

365. "Advancing the Mechanical Properties of Thermoplastic Elastomer Fibrous Mats," Society of Plastics Engineers 18th Thermoplastic Elastomers Topical Conference (TOPCON), Akron, OH, 2022.

364. "Functional Thermoplastic Elastomers to Meet Contemporary Needs," 2nd Global Summit on Polymer Science and Composites, Barcelona, Spain, 2022 [plenary].

363. "Functional Thermoplastic Elastomers to Meet Contemporary Needs," Department of Materials Science & Physical Chemistry, University of Barcelona, Barcelona, Spain, 2022.

362. "An Integrated Materials Approach to Ultraselective Polymer Membranes for Carbon Capture: Breaking through the Upper Bound," American Chemical Society National Meeting, Chicago, IL, 2022 [Roy W. Tess Award Lecture].

361. "Broad-Spectrum Self-Disinfecting Polymer Surfaces: Preparing for Future Health Crises," 2nd International Conference on Nature-Inspired Surface Engineering, Seoul, South Korea, 2022.

360. "Nanoporous Inorganic Nanostructures Generated on the Surfaces of Polymer Films and Fibers," Academia International Webinar on Materials Science & Engineering, virtual conference, 2022 [keynote].

359. "Broad-Spectrum Self-Disinfecting Polymer Surfaces: Preparing for Future Health Crises," Science Society, virtual seminar, 2022.

358. "Broad-Spectrum Self-Disinfecting Polymer Surfaces: Preparing for Future Health Crises," Nano Tech 2022: Global Virtual Summit on Nanoscience & Nanotechnology, virtual conference, 2022 [keynote].

357. "A Surface-Engineering Approach to Ultraselective Polymer Membranes for Enhanced Carbon Capture," 6th International Conference on Bioinspiration and Biobased Materials, Nice, France, 2022 [keynote].

356. "Ultraselective Polymer Membranes for Carbon Capture," International Webinar on Polymer Science and Composite Materials, virtual conference, 2022 [keynote].

355. "Functionalization of Block Polymers: From Fundamental Understanding to Advanced Technologies," The Society of Polymer Science, Japan, National Meeting, virtual conference, 2022 [SPSJ International Award Lecture].

354. "Ultraselective Polymer Membranes for Carbon Capture," Chemical Engineering and Catalysis World Forum, virtual conference, 2022 [plenary].

353. "An Integrated Materials Approach to Ultraselective Polymer Membranes for Carbon Capture: Breaking through the Upper Bound," Science Society, virtual seminar, 2022.

352. "Functionalization of Block Polymers: From Fundamental Understanding to Advanced Technologies," School of Polymer Science & Engineering, University of Akron, Akron, OH, 2022.

351. "Functionalization of Block Polymers: From Fundamental Understanding to Advanced Technologies," 13th Annual Conferencxe on Polymer Science & Engineering, virtual conference, 2022 [keynote].

350. "Nonpolar and Charged Thermoplastic Elastomer Gels: Stimuli-Responsiveness & Technological Opportunities," Department of Mechanical Engineering, San Diego State University, San Diego, CA, 2022.

349. "Continuously Self-Disinfecting and Broad-Spectrum Polymers: Next Steps toward Preventing the Spread of Highly Contagious Microbes," Materials Research Society National Meeting, Boston, MA, 2021.

348. "Soft Nanotechnology to Mitigate Global Climate Change: Engineering Ultrahigh CO_2-Selective Membranes from the Ground-Up," 5th Conference on Emerging Materials and Processes, virtual conference, 2021 [keynote].

347. "Advances in Analyzing and Applying the Properties of Nanocellulose," 5th Virtual Edition of Polymers, Plastics and Composites Conference, virtual conference, 2021 [keynote].

346. "Preventing the Next Pandemic with Broad-Spectrum, Self-Disinfecting Antimicrobial Polymers," 7th NANO Boston Conference, virtual conference, 2021 [plenary].

345. "Interactions of Nanocellulose with Water: Advances in Fundamental Insights, Properties and Applications," 2nd International Symposium on Water, Ecology and Environment, virtual conference, 2021 [plenary].

344. "Charged Block Polymers: New Insights and New Opportunities," Department of Chemical & Biomolecular Engineering, Pennsylvania State University, State College, PA, 2021.

343. "Charged Block Polymers as Next-Generation Broad-Spectrum, Self-Sterilizing Antimicrobial Surfaces" and "Nanoscale Materials Strategies toward Ultraselective Polymer Membranes for Carbon Capture," Department of Chemical Engineering, Bucknell University, Lewisburg, PA, 2021

342. "Nanoscale Materials Strategies toward Ultraselective Polymer Membranes for Carbon Capture: Breaking through the Upper Bound," Department of Chemical & Biomolecular Engineering, University of Arkansas, Fayetteville, AR, 2021.

341. "Morphological Studies of Nanostructured Block Copolymers: Marrying Fundamental Insight to Practical Application," Kraton Innovation Center, Kraton Corporation, Houston, TX, 2021.

340. "Charged Block Polymers: New Insights and New Opportunities," Department of Chemical & Biomolecular Engineering, University of Houston, Houston, TX, 2021.

339. "Chemical Modification of Polyester Polyols: Creating New Materials by Combining Simulations and Experiments," Global Virtual Summit on Catalysis and Chemical Engineering, virtual conference, 2021 [keynote].

338. "Novel Material Strategies to Ultraselective Membranes for CO_2 Capture, "International Conference on Polymer Science and Composite Materials, virtual conference, 2021 [plenary].

337. "There and Back Again: A Professor's Tale," 60th Birthday Websymposium on Functional Polymeric Materials, International Association of Advanced Materials, virtual conference, 2021 [plenary].

336. "Novel Material Strategies to Ultraselective Membranes for CO_2 Capture," 5th International Conference

on Fossil & Renewable Energy, virtual conference, 2021 [keynote].

335. "Strategic Use of Elastomers to Prevent the Spread of Infectious Diseases," Rubber Innovation Research Institute, Prince of Songkla University, webinar, 2021.

334. "Fast-Acting, Self-Disinfecting Macromolecular Strategies Aimed at Preventing the Spread of Highly Contagious Pathogens," International Online Conference on Macromolecules, virtual conference, 2020 [plenary].

333. "Elastomers that *Activate* in the Presence of Environmental Factors to *Inactivate* Contagious Microbes in the Environment," International Symposium on Water, Ecology and Environment, virtual conference, 2020 [keynote].

332. "Addressing Global Climate Change: Designing the Nanoscale Structure of CO_2-Selective Polymer Membranes," Webinar on Material Science and Nanotechnology, virtual conference, 2020 [keynote].

331. "Advances in Antimicrobial Design: Thwarting the Spread of COVID-19," 4th Global Innovators Summit, virtual conference, 2020 [keynote].

330. "Tailoring the CO_2 Permeability and Selectivity of Organic Membranes from the Ground-Up," 2nd International Conference on Materials Science & Engineering, virtual conference, 2020 [keynote].

329. "Elucidating the Contributions of Network Topologies in Multiblock Copolymers," Webinar on Materials Science, Engineering and Technology, virtual conference, 2020 [VSET Fellow Lecture].

328. "Strategic Routes to Comprehensive Antimicrobial Polymers," 5th International Conference on Bioinspired and Biobased Chemistry and Materials, virtual conference, 2020 [keynote].

327. "Solution Flow/Phase Behavior, Film Property Modification and Gas-Separation Attributes of Nanocellulose," 5th International Conference on Bioinspired and Biobased Chemistry and Materials, virtual conference, 2020 [keynote].

326. "Polyester Polyol Thermosets Varying in Composition: From Molecular Simulations to Material Properties," First International Online Conference on Blends, Composites, Bio-composites and Nanocomposites, virtual conference, 2020 [plenary].

325. "Advances in Analyzing and Applying the Properties of Nanocellulose," Green, Sustainable & Analytical Chemistry, virtual conference, 2020.

324. "Strategic Routes to TPE Designs for Broad-Spectrum Antimicrobial Performance," SPE Thermoplastic Elastomers 2020, virtual conference, 2020 [keynote].

323. "Multiscale Advances in Electroelastomers for Energy-Efficient and Controllable Shape Transformation," International Conference on Mechanical & Aerospace Engineering and Aerodynamics, virtual conference, 2020 [keynote].

322. "Materials Strategies to Prevent the Spread of Highly Contagious Pathogens," Materials Summit 2020, virtual conference, 2020 [keynote].

321. "Tailoring the CO_2 Permeability and Selectivity of Organic Membranes from the Ground-Up," International Association of Advanced Materials, Sweden, Advanced Materials Lecture Series, virtual conference, 2020 [IAAM Fellow Lecture].

320. "Promising Strategies Toward Highly Effective and Broad-Spectrum Anti-Infective Polymers and Coatings," Smart Coatings 2020, Orlando, FL, 2020.

319. "Thermoplastic Elastomer Gels: From Fundamental Network Studies to Tunable Soft Materials," 10th China International Conference on Functional Materials and Applications and 6th International Conference on Multi-Functional Materials and Structures, Chongqing City, China, 2019 [keynote].

318. "Controlling the Nanostructure of Charged Block Polymers for Energy-, Environment- and Health-Related Technologies," School of Mechanical and Automotive Engineering, South China University of Technology, Guangzhou, China, 2019.

317. "Nanostructured Block Ionomers: Morphological Control & Contemporary Technologies," Institute for Polymer Chemistry, Universität Stuttgart, Stuttgart, Germany, 2019.

316. "Thermoplastic Elastomers: From Polymer Architecture to Materials" and "Applications of Advanced Electron Microscopy in Polymer Science," Institute of Organic Chemistry, Johannes Gutenberg Universität Mainz, Mainz, Germany, 2019.

315. "Membrane Design Strategies for Mitigating Global Climate Change by CO_2 Capture," NanoBioMedical Center, Adam Mickiewicz University, Poznan, Poland, 2019.

314. "Tremendous Potential of Block Ionomers as Gas-Separation Membranes," Joint Workshop on Polymeric Membranes for CO_2 Capture," Trondheim, Norway, 2019.

313. "Designing Comprehensive Self-Sterilizing Surfaces: Staying Ahead of a Growing Global Threat," NanoTech Poland International Conference & Exhibition, Poznan, Poland, 2019.

312. "Charged Multiblock Polymers: From Cosolvent-Templated Self-Assembly to Ultrapermeable Gas-Separation Membranes," 32nd International Symposium on Polymer Analysis and Characterization," Sendai, Japan, 2019.

311. "Thermodynamics of Theology: Balancing Enthalpy, Entropy and Faith," Fides et Ratio Series, Adam Mickiewicz University, Poznan, Poland, 2019.

310. "Charged Thermoplastic Elastomers for 21st Century Soft Nanotechnologies," Department of Chemistry, American University in Cairo, Cairo, Egypt, 2019.

309. "Designing Polymeric Materials as Comprehensive Anti-Infective Surfaces: Staying Ahead of a Growing Global Threat," Department of Chemistry, University of Victoria, Victoria, Canada, 2019.

308. "Photodynamic Polymers as Comprehensive Anti-Infective Materials: Staying Ahead of a Growing Global Threat," Department of Chemical Engineering, Norwegian University of Science & Technology, Trondheim, Norway, 2019.

307. "Adhesion and Stability Considerations Regarding Fiber-Reinforced Plastics," Saint-Goban High-Performance Materials Workshop, North Carolina State University, Raleigh, NC, 2018.

306. "Nonpolar and Charged Thermoplastic Elastomer Gels: Morphological Development, Stimuli-Responsiveness & Technological Opportunities," Institute for Polymer Research, Helmholtz-Zentrum Geesthacht, Geesthacht, Germany, 2018.

305. "Designing Selective Membranes from the Ground-Up: A Polymer Scientist's Playground," Integrative Research Institute for the Sciences, Humboldt Universität zu Berlin, Berlin, Germany, 2018.

304. "Thermoplastic Elastomer Gels as Morphologically and Mechanically Complex Soft Materials," Institute of Organic Chemistry, Johannes Gutenberg Universität Mainz, Mainz, Germany, 2018.

303. "Multiscale Design of Elastomeric Materials as Energy-Efficient Dielectric Elastomers for Electroresponsive Technologies," Department of Materials Science & Metallurgy, Warsaw University

of Technology, Warsaw, Poland, 2018.

302. "Photodynamic Polymers as Comprehensive Self-Sterilizing Materials: Staying Ahead of a Growing Global Threat," Biological and Chemical Research Center, University of Warsaw, Warsaw, Poland, 2018.

301. "Block Copolymer Hierarchical Morphologies and Customized Functionality Inspired by Nature," 4th International Conference on Bioinspired and Biobased Chemistry and Materials, Nice, France, 2018 [keynote].

300. "Directed Self-Assembly of Block Copolymers as a Route to Novel Hierarchical Superstructures," Department of Chemistry, University of Warsaw, Warsaw, Poland, 2018 (repeat seminar).

299. "Nonpolar and Charged Thermoplastic Elastomer Gels: Stimuli-Responsiveness & Technological Opportunities," Department of Mechanical Engineering, University of Hong Kong, Hong Kong, China, 2018.

298. "Thermoplastic Elastomer Gels: From Simple Stretchy Materials to Morphologically Complex Responsive and Functional Systems," Department of Chemical and Biochemical Engineering, Zhejiang University, Hangzhou, China, 2018.

297. "Directed Self-Assembly of Block Copolymers as a Route to Novel Hierarchical Superstructures," Department of Polymer Science and Engineering, Zhejiang University, Hangzhou, China, 2018.

296. "Multiscale Design of Elastomeric Materials as Energy-Efficient Dielectric Elastomers for Electroresponsive Technologies" and "Thermoplastic Elastomer Gels: From Simple Stretchy Materials to Morphologically Complex Responsive and Functional Systems," School of Chemistry and Chemical Engineering, Shanghai Jiao Tong University, Shanghai, China, 2018.

295. "Directed Self-Assembly of Block Copolymers as a Route to Novel Hierarchical Superstructures" and "Thermoplastic Elastomer Gels: From Simple Stretchy Materials to Morphologically Complex Responsive and Functional Systems," Herbert Gleiter Institute of Nanoscience, Nanjing University of Science & Technology, Nanjing, China, 2018.

294. "Crystallization-/Coordination-Directed Self-Assembly of Block Copolymers," Department of Materials Science & Engineering, Peking University, Beijing, China, 2018.

293. "Solvent Templating and Solvent-Vapor Annealing of Charged Thermoplastic Elastomers," Soft Matter Lecture Series, Peking University, Beijing, China, 2018.

292. "Rethinking Soft Elastomers from Composition-Tunable Thermoplastic Elastomer Gels that Exhibit Rich Phase and Property Behaviour" and "Strategic Functionalization of Block Copolymers and Controlling the Phase Behaviour of Block Ionomers for Contemporary Technologies," Department of Chemical Engineering, Middle East Technical University, Ankara, Turkey, 2018.

291. "Polymer Coatings: For Food Preservation, Wearable Electronics and Everything Else," NanoBioMedical Center, Adam Mickiewicz University, Poznan, Poland, 2018.

290. "Photodynamic Polymers as Comprehensive Anti-Infective Materials: Staying Ahead of a Growing Global Threat," Department of Physics and NanoBioMedical Center, Adam Mickiewicz University, Poznan, Poland, 2018.

289. "Directed Self-Assembly of Block Copolymers as a Route to Novel Hierarchical Superstructures," Department of Chemistry, University of Warsaw, Warsaw, Poland, 2018.

288. "Anisotropic Nanoparticles and Unique Hierarchical Superstructures from the Directed Self-Assembly

of Block Copolymers" and "Universal and Tunable Polymeric Coating for Functionalizing Inert Polymer and Inorganic Surfaces," Institute for Nanomaterials, Advanced Technologies & Innovation, Technical University of Liberec, Liberec, Czech Republic, 2018.

287. "Self-Assembly of Charged Thermoplastic Elastomers: From Start to Application," Department of Chemical Engineering, Norwegian University of Science & Technology, Trondheim, Norway, 2018.

286. "Selective Midblock Modification of Thermoplastic Elastomers: Phase Behavior, Stimuli-Responsiveness and Unexpected Functionality," Soft Matter and Chemistry Laboratory, École Supérieure de Physique et de Chimie Industrielles, Paris, France, 2018.

285. "Functionalized Thermoplastic Elastomers: A Route to Designer Soft Nanomaterials," NanoTech Poland International Conference & Exhibition, Poznan, Poland, 2018 [plenary].

284. "Preparation, Characterization and Uses of Midblock-Functionalized Multiblock Copolymers," Technische Universität Berlin International Graduate Research Training Program, Potsdam, Germany, 2017.

283. "Advances in Nanostructured Soft Materials," Department of Chemistry, St. Joseph's College, Moolamattom, India, 2017.

282. "Morphological and Spectroscopic Studies of Crystallizable Block Copolymers: From Directed Self-Assembly to Molecular Dynamic Analysis," International Conference on Molecular Spectroscopy, Mahatma Gandhi University, Kottayam, India, 2017 [plenary].

281. "Thermoplastic Elastomer Gels as a Tunable Class of Soft Materials," "Controlling the Morphology and Properties of Charged Thermoplastic Elastomers," and "Transmission Electron Microtomography in Polymer Science: Opportunities to Visualize 3D Nanoscale Morphologies," International and Inter University Centre for Nanoscience and Nanotechnology, Mahatma Gandhi University, Kottayam, India, 2017 [Erudite Professor Lecture Series]

280. "Morphological Development & Versatile Properties of Charged Thermoplastic Elastomers," 3rd International Conference on Polymer Science and Engineering, Chicago, IL, 2017 [keynote].

279. "Morphological and Phase Studies of Designer Block Copolymer Systems," Small-Angle Scattering Interest Group, Argonne National Laboratory, Argonne, IL, 2017.

278. "Directed Self-Assembly as a Route to Hierarchical Superstructures in Soft Matter," Integrative Research Institute for the Sciences, Humboldt Universität zu Berlin, Berlin, Germany, 2017.

277. "Biomimicry with Block Copolymers: Hierarchical Superstructures by Directed Self-Assembly," Department of Chemistry, Jagiellonian University, Kraków, Poland, 2017.

276. "Directed Self-Assembly of Block Copolymers and the Spontaneous Formation of Hierarchical Superstructures," NanoBioMedical Center, Adam Mickiewicz University, Poznan, Poland, 2017.

275. "Designing Next-Gen Dielectric Elastomers as Stimuli-Responsive Soft Nanomaterials," NanoTech Poland International Conference & Exhibition, Poznan, Poland, 2017.

274. "Biomimicry with Block Copolymers: Directed Self-Assembly via Crystallization or Chemical Coordination," Department of Physics, Adam Mickiewicz University, Poznan, Poland, 2017.

273. "Controlled Self-Assembly of Block Copolymers and the Spontaneous Formation of Hierarchical Superstructures," Corporate Research Division, Procter & Gamble, Cincinnati, OH, 2017.

272. "Charged Thermoplastic Elastomer Gels: Technological Opportunities and Self-Assembly Behavior,"

Department of Chemistry, University of South Carolina, Columbia, SC, 2017.

271. "Charged Thermoplastic Elastomers: Technological Opportunities through Templated Self-Assembly," Kraton Polymers, Houston, TX, 2017.

270. "Emerging Opportunities for Thermoplastic Elastomer Gels: Teaching an Old Dog New Tricks," Adidas, Portland, OR, 2017.

269. "Bottlebrush Elastomers: A Promising Molecular Engineering Route to Tunable, Prestrain-Free Dielectric Elastomers," SPIE Smart Structures/NDE National Meeting, Portland, OR, 2017.

268. "New Technological Insights and Opportunities for Nonpolar and Charged Thermoplastic Elastomer Gels," Nike, Portland, OR, 2017.

267. "Advances in Thermoplastic Elastomer Gels as Highly Tunable Responsive Media," 11th International Gel Symposium, Nihon University, Chiba, Japan 2017 [keynote].

266. "Nonpolar and Charged Thermoplastic Elastomer Gels: Reprocessable and Recyclable Functional Soft Materials for a Sustainable Future," Institute of Multidisciplinary Research for Advanced Materials, Tohoku University, Sendai, Japan, 2017.

265. "Nonpolar and Charged Thermoplastic Elastomer Gels: Exploring New Technological Opportunities for Soft Materials" and "Functional Polymer Nanocomposites and Polymer Nano-objects: A Panacea for Emerging Contemporary Nanotechnologies," Research & Development Division, Kuraray Co., Tsukuba, Japan, 2017.

264. "Hierarchical Superstructures and Mesoporous Membranes from the Coordination-Driven Self-Assembly of Block Copolymers," Department of Chemical Engineering, Norwegian University of Science & Technology, Trondheim, Norway, 2017.

263. "Self-Assembled Polymers: Letting Nature Build Beauty and Function from the Ground-Up," Science Colloquium Series, Shaw University, Raleigh, NC, 2016.

262. "A New Age of Functional and Responsive Thermoplastic Elastomers: Discovering a Buried Treasure," Australian Polymer Society Annual Meeting, Lorne, Australia, 2016 [plenary].

261. "Nano/meso/microscale Design of Elastomers as Energy-Efficient Dielectric Elastomers," Department of Chemical & Biomolecular Engineering, University, of Melbourne, Melbourne, Australia, 2016.

260. "Controlling Morphological and Property Development in Charged Thermoplastic Elastomers," Annual Meeting of the International Graduate Research Training Group on Self-Assembled Soft-Matter Nanostructures at Interfaces, Neuruppin, Germany, 2016.

259. "Anisotropic Nanoparticles and Hierarchical Superstructures from the Coordination-Driven Self-Assembly of Block Copolymers," Colloquium of the International Graduate Research Training Group on Self-Assembled Soft-Matter Nanostructures at Interfaces, Technische Universität Berlin, Berlin Germany, 2016.

258. "Controlling the Morphological and Property Development in Charged Thermoplastic Elastomers for Emerging Applications," Department of Materials Science & Engineering, Carnegie-Mellon University, Pittsburgh, PA, 2016.

257. "Controlling Morphological and Property Development in Network-Forming Multiblock Ionomers," International Conference on Chemical Engineering, Phoenix, AZ, 2016 [keynote].

256. "Controlling Morphological and Property Development in Network-Forming Multiblock Ionomers,"

School for Engineering of Matter, Transport & Energy, Arizona State University, Tempe, AZ, 2016.

255. "Nano/meso/microscale Design of Elastomers as Energy-Efficient Dielectric Elastomers," Department of Mechanical & Nuclear Engineering, Virginia Commonwealth University, Richmond, VA, 2016.

254. "Controlling the Morphological and Property Development in Network-Forming Multiblock Ionomers," Fakultät für Physik, Lehrstuhl für Funktionelle Materialien, Technische Universität München, München, Germany, 2016.

253. "Nanoengineering Macromolecular Systems to Yield Soft Materials with Novel Properties," Particulate Nanosystems Collaborative Research Centre, University of Bayreuth, Bayreuth, Germany, 2016.

252. "The Dawning of a New Age for Thermoplastic Elastomers as Functional Materials," Department of Physics, Adam Mickiewicz University, Poznan, Poland, 2016.

251. "Stabilization of Polymer/Polymer Nanolaminates: Block Copolymers *vs*. Nanogel Particles," NanoBioMedical Center, Adam Mickiewicz University, Poznan, Poland, 2016.

250. "Network-Forming Multiblock Ionomers: Controlling Phase Behavior for Diverse Technological Applications," NanoTech Poland International Conference & Exhibition, Poznan, Poland, 2016.

249. "Supramolecular Nonwovens," Southern Textile Research Conference, Myrtle Beach, SC, 2016.

248. "Visualizing and Quantifying the 3D Nanoscale Characteristics of Nanostructured Polymeric Materials," Department of Environmental Science & Engineering, King Abdullah University of Science & Technology, Thuwal, Saudi Arabia, 2016.

247. "Morphological Studies and Versatile Properties of Network-Forming Multiblock Ionomers," Department of Environmental Science & Engineering, King Abdullah University of Science & Technology, Thuwal, Saudi Arabia, 2016.

246. "Fabrication Strategies for Exploring the Anisotropic Electroactuation of Dielectric Elastomers," SPIE Smart Structures/NDE National Meeting, Las Vegas, NV, 2016.

245. "Functional Thermoplastic Elastomers: Stretchy Materials that Provide New Insights and Opportunities," Australian Institute for Nanoscale Science and Technology, University of Sydney, Sydney, Australia, 2016.

244. "Controlling the Morphological and Property Development in Network-Forming Multiblock Ionomers," Australian Research Council Centre of Excellence for Electromaterials Science, University of Wollongong, Wollongong, Australia, 2016.

243. "Soft Materials Research at NC State and the Research Triangle," University Global Partnership Network Annual Meeting & Workshops, University of Wollongong, Wollongong, Australia, 2016.

242. "Morphological Studies and Versatile Properties of Network-Forming Multiblock Ionomers," School of Chemical Technology, Aalto University, Helsinki, Finland, 2016.

241. "Fundamental Aspects and Promising Attributes of Midblock-Sulfonated Block Ionomers," Department of Chemical Engineering, Mid Sweden University, Sundsvall, Sweden, 2016.

240. "Packaging: Cutting-Edge Science & Technological Opportunities," BASF iTeam Workshop, Raleigh, NC, 2015.

239. "Micro/Nanocomposites for Responsive Media: Dielectric Elastomers and Piezoresistive Sensors," NCSU/PSU Center for Dielectrics and Piezoelectrics, Raleigh, NC, 2015.

238. "Fundamental Principles and Emerging Opportunities for Nanostructured Thermoplastic Elastomer Systems," Department of Textile Engineering, Chemistry and Science, North Carolina State University, Raleigh, NC, 2015.

237. "Visualizing and Quantifying the 3D Nanoscale Characteristics of Polymeric Materials by Transmission Electron Microtomography," Department of Chemistry, University of Bristol, Bristol, United Kingdom, 2015.

236. "Block Copolymer Gel Networks: A Remarkably Versatile Platform for Functional Soft Matter," Department of Materials Science & Metallurgy, University of Cambridge, Cambridge, United Kingdom, 2015.

235. "New Design Paradigms for Using Block Copolymers and Microgel Nanoparticles to Stabilize Polymer Thin Films," Soft Matter Group, University of Surrey, Surrey, United Kingdom, 2015.

234. "Small-Angle Scattering of Solvated Block Ionomers," 1st ORNL-Duke Workshop on Neutron Sciences, Duke University, Durham, NC, 2015.

233. "Functional Polymer Nanocomposites: We've Come a Long Way…," Center for Supramolecular Systems and Self-Association Processes, Institute of Macromolecular Chemistry, Prague, Czech Republic, 2015.

232. "Polymer Nanostructures, Nanocomposites and Networks (PN3)," Patch Rubber Company, Weldon, NC, 2015.

231. "Physical Design of Shape-Memory Polymers and Wires with On-Demand Programmability," 13th International Conference of Polymers for Advanced Technologies, Hangzhou, China, 2015.

230. "Morphological Studies of Charged Triblock Copolymers Used in Organic Photovoltaics," Collaborative Conference on 3D and Materials Research," Busan, South Korea, 2015.

229. "Development of Responsive Soft Matrices for Adaptive Personnel Armor (APA)," DSM Dyneema, Greenville, NC, 2015.

228. "Strategies for Stabilizing Polymer Thin Films," Department of Chemical Engineering, Norwegian University of Science and Technology, Trondheim, Norway, 2015.

227. "Diversifying the Portfolio of Thermoplastic Elastomers with No Retirement in Sight," Society of Plastics Engineers ANTEC Meeting, Orlando, FL, 2015 [International Award Keynote Lecture].

226. "Thermoplastic Elastomer Gels: Versatile Soft Materials for the 21st Century," ExxonMobil Chemical Co., Baytown, TX, 2014.

225. "Engineering the Polymer/Polymer Interface in Thin-Film Nanolaminates," Department of Chemistry, Peking University, Beijing, China, 2014.

224. "Contemporary Topics in Polymer Nanostructures and Nanocomposites," Department of Chemical Engineering, Tsinghua University, Beijing, China, 2014.

223. "Thermoplastic Elastomer Gels: From Network Basics to Functional Materials," U.S. Army Research Laboratory, Aberdeen, MD, 2014.

222. "Designing Synthetic Muscle from (Nano)Structured Dielectric Elastomers," 2nd International Conference on Bioinspired and Biobased Chemistry and Materials, Nice, France, 2014 [keynote].

221. "A New Age for Thermoplastic Elastomers as Functional Materials," Naval Research Laboratory, Alexandria, VA, 2014.

220. "Practical Transmission Electron Microscopy in Soft Matter Nanoscience," Department of Chemical Engineering, Istanbul Technical University, Istanbul, Turkey, 2014.

219. "Insights into the Design and Development of Intriguing Polymer Nanocomposites," Department of Polymer Engineering, Yalova University, Yalova, Turkey, 2014.

218. "Emerging Strategies by which to Functionalize Electrospun Polymer Nano/ microfibers," Department of Chemical Engineering, Istanbul Technical University, Istanbul, Turkey, 2014.

217. "Exploiting Self-Assembled Polymer Systems for Separation Processes," Department of Chemical Engineering, Istanbul Technical University, Istanbul, Turkey, 2014.

216. "Exploiting Block Copolymer Self-Assembly for Gas Separations," 20th Anniversary MEMFO Symposium, Norwegian University of Science & Technology, Trondheim, Norway, 2014.

215. "Thermoplastic Elastomers as Stimuli-Responsive Materials," Polymer Physics Seminar Series, Pennsylvania State University, University Park, PA, 2014.

214. "An Overview of Emerging Opportunities in Polymer Science," SINTEF Materials & Chemistry, Oslo, Norway, 2014.

213. "3D Visualization of Soft Nanomaterials," Institute of Product Design, Høgskolen i Oslo og Akershus, Kjeller, Norway, 2014.

212. "Engineering the Polymer/Polymer Interface," NIST PSI Consortium Meeting, North Carolina State University, Raleigh, NC, 2014.

211. "Marrying Nanotechnology and the Rubber Band to Obtain Synthetic Muscle," TEDxNCSU, North Carolina State University, Raleigh, NC, 2014.

210. "Renaissance of Thermoplastic Elastomer Gels as Next-Generation Soft and Stretchable Materials," American Chemical Society National Meeting, Dallas, TX, 2014.

209. "(Electro)Mechanical Properties of Olefinic Block Copolymers," American Physical Society National Meeting, Denver, CO, 2014.

208. "Unidirectional Dielectric Elastomer Composites with High-Dielectric-Constant Fibers," Department of Mechanical Engineering, University of Nevada Las Vegas, Las Vegas, NV, 2014.

207. "Thermoplastic Elastomers: From Fundamental Beginnings to a Smart Future," Eastman Chemical Co., Kingsport, TN, 2013.

206. "Elastomer-Based Stimuli-Responsive Materials: From Electroactive and Shape-Memory Media to Strain-Reversible Piezoresistive Sensors," Institute for Materials Research and Innovation, University of Bolton, Bolton, United Kingdom, 2013.

205. "Thermoplastic Elastomer Systems for Stimulated Shape Change: From Electrical Actuation to Thermal Recovery," Fiber Society International Symposium, Clemson University, Clemson, SC, 2013.

204. "ADEPT Polymers: Anisotropic Electroactuation by Design," 7th World Congress on Biomimetics, Artificial Muscles and Nano-Bio, Jeju Island, South Korea, 2013 [keynote].

203. "Electroactuation of Dielectric Thermoplastic Elastomer Gels: Decoupling the Roles of Mechanical

Prestrain and Specimen Thickness," Korean Advanced Institute of Science & Technology, Daejeon, South Korea, 2013.

202. "Thermoplastic Elastomer Networks: Formation and Incorporation of Midblock-Selective (Co)Solvents," Department of Materials Science & Engineering, Beijing University of Chemical Technology, Beijing, China, 2013.

201. "Block Copolymers at Polymer/Polymer Interfaces in Nanolaminates: Stabilizing and Destabilizing Attributes," Department of Chemical Engineering, Tsinghua University, Beijing, China, 2013.

200. "Conductive Polymer Nanocomposites as Soft Printable Sensors Exhibiting Strain-Reversible Piezoresistivity," Conference on Nanomaterials and Conference on New Technologies of Chemical Engineering, Beijing, China, 2013.

199. "Stability of Polymer Thin Films: New Twists to an Old Problem," Whirlpool Corporation, Benton Harbor, MI, 2013.

198. "Thermoplastic Elastomers as a General Design Platform for use as Responsive Materials," Department of Soft Matter and Functional Materials, Helmholtz Center for Materials and Energy, Berlin, Germany, 2013.

197. "Practical Transmission Electron Microscopy in Soft Matter Nanoscience," International Graduate Research Training Program, Technische Universität Berlin, Berlin, Germany, 2013.

196. "Electroactive Polymers Containing Fibrous or Continuous High-Dielectric Constituents," 3rd International Conference on Electromechanically Active Polymer (EAP) Transducers and Artificial Muscle," Zurich, Switzerland, 2013 [opening plenary].

195. "Thermoplastic Elastomers as a Design Platform for Energy-Efficient Electroactive Systems," Department of Chemical Engineering, Lehigh University, Lehigh, PA, 2013.

194. "Selectively-Swollen Thermoplastic Elastomers for use in Energy-Efficient Electro-responsive Systems," Department of Chemical & Biological Engineering, Drexel University, Philadelphia, PA, 2013.

193. "The Future of Modified Thermoplastic Elastomers as a Class of Soft Materials for Advanced Technologies," The Polymer Society, Queen Mary University of London, London, United Kingdom, 2012 [The Rubber Foundation Lecture].

192. "Transmission Electron Microtomography of Nanostructured Polymer Systems: Successes and Opportunities," Department of Physics & Astronomy, University of Waterloo, Waterloo, Canada, 2012.

191. "There and Back Again: A Professor's Tale," Schuylkill Campus Alumni Seminar Series, Pennsylvania State University, Schuylkill Haven, PA, 2012.

190. "On the Versatility of Silk Fibroin as a Designer Polymer," 1st International Conference on Bioinspired and Biobased Chemistry and Materials, Nice, France, 2012 [keynote].

189. "On the Origin and Swelling Behavior of Physical Networks in Thermoplastic Elastomers," Bridgestone Americas, Akron, OH, 2012.

188. "Practical Analytical Microscopy in Soft Matter Nanoscience," Department of Chemical Engineering, Norwegian University of Science and Technology, Trondheim, Norway, 2012.

187. "The Opportunities of Taking a Rubber Band into the 21st Century," Norwegian University of Science and Technology, Trondheim, Norway, 2012. [Lars Onsager Lecture]

186. "Novel Technological Opportunities with Selectively-Swollen Thermoplastic Elastomers," Kimberly-Clark Corp., Roswell, GA, 2012.

185. "Positioning Functionalized Nanoparticles in Nanoscale Templates and Fibers," Department of Materials Engineering, Indian Institute of Science, Bangalore, India, 2012.

184. "Thermoplastic Elastomers in the Presence of Midblock-Selective Cosolvents," 3rd International Multicomponent Polymer Conference, Mahatma Gandhi University, Kottayam, India, 2012.

183. "Stabilizing and Destabilizing Attributes of Block Copolymers at Polymer/Polymer Interfaces: New and Unexpected Insights," 3rd International Multicomponent Polymer Conference, Mahatma Gandhi University, Kottayam, India, 2012 [opening keynote].

182. "Practical Transmission Electron Microscopy in Soft Matter Nanoscience," International Graduate Research Training Program, Technische Universität Berlin, Berlin, Germany, 2012.

181. "Generation of Functional PET Microfibers via Surface-Initiated Polymerization," Smart Coatings 2012, Orlando, FL, 2012.

180. "A New Nanotechnology Platform: Block Copolymer/Ionomer Networks as Versatile & Energy-Efficient Electroactive Systems," Department of Chemical Engineering, Norwegian University of Science & Technology, Trondheim, Norway, 2012.

179. "Block Copolymers/Ionomers for use in Energy-Efficient Electroactive Systems," BD Technologies, Research Triangle Park, NC, 2012.

178. "Positioning Functionalized Nanoparticles in Nanoscale Templates and Fibers," Department of Chemical Engineering, Imperial College, London, United Kingdom, 2011.

177. "In-Plane (De)Stabilization and Nanostructural Templating of Polymer/Polymer Interfaces," Department of Chemical Engineering, Istanbul Technical University, Istanbul, Turkey, 2011.

176. "Block Copolymers and Nanogel Particles at Polymer/Polymer Interfaces," IUPAC 9th International Conference on Advanced Polymers via Macromolecular Engineering, Cappadocia, Turkey, 2011.

175. "Selectively-Solvated Multiblock Ionomers as Electroresponsive Networks," American Chemical Society National Meeting, Denver, CO, 2011.

174. "Control over the Spatial Distribution of Functionalized Nanoparticles by Using Nanoscale Templates and Fibers," Department of Mechanical and Materials Engineering, University of Denver, Denver, CO, 2011.

173. "Exciting New Possibilities for the Rubber Industry in the 21st Century: Thermoplastic Elastomers with Highly Tunable (Electro)Mechanical Properties," Department of Mechanical Engineering, Prince of Songkla University, Hat Yai, Thailand, 2011.

172. "Reinventing the Role of Thermoplastic Elastomers as Electroactive Polymers," Kraton Polymers, Houston, TX, 2011.

171. "Multiple Opportunities for Copolymers in Thin-Film Polymer Nanolaminates," Department of Materials Science & Engineering, Clemson University, Clemson, SC, 2011.

170. "Exciting New Opportunities for Block Copolymers as Versatile Electroactive Polymers," National Materials Research Society Meeting, Boston, MA, 2010.

169. "Block Copolymers and Nanogel Particles at Polymer/Polymer Interfaces: New and Unexpected Possibilities," Department of Materials Science & Engineering, University of California, Los Angeles, CA, 2010.

168. "To Self-Assemble or Modify Interfaces? That is the Question (We Ask of Block Copolymers)," School of Materials, University of Manchester, Manchester, United Kingdom, 2010.

167. "Triblock Copolymer Networks: From Formation to Electroactuation," Department of Materials Science & Mechanical Engineering, Harvard University, Cambridge, MA, 2010.

166. "Triblock Copolymer Networks: From Formation to Electroactuation," Department of Materials Science & Manufacturing, Center for Scientific and Industrial Research, Port Elizabeth, South Africa, 2010.

165. "Triblock Copolymer Networks: From Formation to Electroactuation," Department of Chemical & Biomolecular Engineering, Clemson University, Clemson, SC, 2010.

164. "3D TEM Imaging of Nanostructured Polymer Systems," Department of Chemistry, University of North Carolina, Chapel Hill, NC, 2010.

163. "In-Plane Heterogeneities at Polymer/Polymer Interfaces," Department of Materials Chemistry, SINTEF, Trondheim, Norway, 2010.

162. "Nanostructured Block Copolymers: A Molecular and Systems Design Approach," Department of Chemical & Biomolecular Engineering, North Carolina State University, Raleigh, NC, 2010.

161. "New Insights into Nanostructured Block Copolymers: Networks, Membranes, Nanocomposites and Electroelastomers," Department of Chemical Engineering, University of South Carolina, Columbia, SC, 2008.

160. "Transmission Electron Microtomography of Nonequilibrium Polymer Surfaces and Interfaces," 14th European Microscopy Congress, Aachen, Germany, 2008.

159. "Triblock Copolymer Networks as Membranes, Nanocomposites and Dielectric Elastomers," Institut für Festkörperphysik, Technische Universität Darmstadt, Darmstadt, Germany, 2008.

158. "Molecular Networks in Thermoplastic Elastomer Systems for Use as Dielectric Elastomers," American Chemical Society Rubber Division, Annual Spring Technical Meeting, Dearborn, MI, 2008.

157. "New Insights into Nanostructured Block Copolymers: Networks, Membranes, Nanocomposites and Gels," Department of Chemical & Biomolecular Engineering, Tulane University, New Orleans, LA, 2008.

156. "New Insights into, and Opportunities for, Microphase-Ordered Block Copolymers Containing Selective Solvents or Nanoparticles," Department of Polymer Science, University of Akron, OH, 2008.

155. "Molecular Design of Nanostructured Block Copolymers as a Route to High-Performance Electroelastomers," Liquid Crystal Institute, Kent State University, Kent, OH, 2008.

154. "Block Copolymers as a New Design Platform for High-Performance Electroactive Polymers," Department of Chemical Engineering, University of Rochester, Rochester, NY, 2007.

153. "The Growing Need for Electron Tomography in Polymer Nanoscience," German Society for Electron Microscopy Annual Meeting, Saarbrücken, Germany, 2007 [Ernst Ruska Distinguished Lecture].

152. "Transmission Electron Microtomography of Multicomponent Block Copolymer Systems," American Chemical Society National Meeting, Boston, MA, 2007.

151. "Analytical Electron and X-ray Microscopy for Use in Gel Research," "Gel Networks in Bulk Polymers," and "SAMIN-Based Organogels: Electroactive Nanostructured Polymers," International Center for Materials Research, University of California, Santa Barbara, CA, 2007.

150. "Nanostructured Polymeric Membranes for Selective CO_2 Removal from Light Gas Mixtures" CO_2 Cooperative Research Center, Department of Chemical & Biomolecular Engineering, University of Melbourne, Melbourne, Australia, 2007.

149. "Modified Polymer Surfaces and Interfaces Using Block Copolymers and Microgel Particles," Polymer Science Group, Department of Chemical & Biomolecular Engineering, University of Melbourne, Melbourne, Australia, 2007.

148. "3D TEM Imaging of Nanostructured Polymer Systems," Department of Chemical & Biomolecular Engineering, University of Melbourne, Melbourne, Australia, 2007.

147. "3D TEM Imaging of Nanostructured Polymer Systems," Centre for Material and Fibre Innovation, Deakin University, Geelong, Australia, 2007.

146. "New Opportunities for Block Copolymers: From Homologous Designer Molecules to Dynamic Multicomponent Systems," Department of Chemical & Biomolecular Engineering, University of Melbourne, Melbourne, Australia, 2007 [Tewkesbury Lecture].

145. "Solvated Block Copolymers as a Novel Class of Electroactive Nanostructured Polymers," American Physical Society National Meeting, Denver, CO, 2007.

144. "New Opportunities for Block Copolymers: From Homologous Designer Molecules to Dynamic Multicomponent Systems," Department of Chemistry, University of Bristol, United Kingdom, 2006.

143. "Modification of Polymer/Polymer Interfaces Using Block Copolymers and Microgel Particles," Electron Microscopy Seminar Series, Department of Materials Science & Metallurgy, University of Cambridge, United Kingdom, 2006.

142. "3D TEM Imaging: An Emerging Analytical Tool in the Study of Soft Nanostructured Materials," Microscience 2006, Royal Microscopical Society, London, United Kingdom, 2006.

141. "Modification of Polymer/Polymer Interfaces Using Block Copolymers and Microgel Particles," Miami Valley Innovation Center, Procter & Gamble, Cincinnati, OH, 2006.

140. "Modification of Polymer/Polymer Interfaces Using Block Copolymers and Microgel Particles," Department of Chemical and Biomolecular Engineering, Ohio State University, Columbus, OH, 2006.

139. "Direct 3D Visualization and Analysis of Complex Soft Nanostructures," American Chemical Society Polymer Discussion Group, Raleigh, NC, 2006.

138. "Molecular-level Information of Block Copolymer Systems from 3D Characterization," American Chemical Society National Meeting, Atlanta, GA, 2006 [Cooperative Research Award Lecture].

137. "Block Copolymers: Directions for New Opportunities" National Starch & Chemicals, Bridgewater, NJ, 2006.

136. "Block Copolymers: A Never-Ending Renaissance?" Milliken Chemicals, Spartanburg, SC, 2006.

135. "Modification of Polymer/Polymer Interfaces Using Block Copolymers and Microgel Particles," Theoretical Division, Los Alamos National Laboratory, Los Alamos, NM, 2005.

134. "Stimuli-Responsive Protein Hydrogels Stabilized by Silk Fibroin," Materials Science and Technology 2005, ASM International and Minerals, Metals & Materials Society, Pittsburgh, PA, 2005.

133. "Transmission Electron Microtomography (TEMT) of Nanostructured Polymers and Polymer Nanocomposites," Microscopy and Microanalysis 2005, Microscopy Society of America, Honolulu, HI, 2005.

132. "Solvated Triblock Copolymers as Shape-Memory Thermoplastic Elastomer Gels," Chemical and Biological Technologies, Sandia National Laboratory, Albuquerque, NM, 2005.

131. "Direct 3-D Visualization and Analysis of Complex Soft Nanostructures," Theoretical Division and Materials Science Division, Los Alamos National Laboratory, Los Alamos, NM, 2005.

130. "Controlling Polymer Phase Behavior and Morphology with High-Pressure CO_2," Department of Chemical Engineering, University of California, Berkeley, CA, 2005.

129. "Non-Traditional Roles of Polymer Nanocomposites in the 21st Century," Department of Chemical & Biomolecular Engineering, University of Melbourne, Melbourne, Australia, 2004.

128. "Direct 3-D Visualization and Analysis of Complex Polymer Nanostructures," Leiden Institute of Chemistry, Leiden University, Leiden, The Netherlands, 2004.

127. "Direct 3-D Visualization and Analysis of Complex Polymer Nanostructures," Stranski Laboratorium für Physikalische und Theoretische Chemie, Technische Universität Berlin, Berlin Germany, 2004.

126. "Nonequilibrium Attributes of Microphase-Ordered Block Copolymer/ Homopolymer Mesoblends," Materials Science Division, Los Alamos National Laboratory, Los Alamos, NM, 2004.

125. "Direct 3-D Visualization and Analysis of Complex Polymer Nanostructures," Department of Chemistry, University of Toronto, Toronto, Canada, 2004.

124. "Molecular and Mesoscopic Design of Multifunctional Polymer Membranes for Gas Separations," Johnson Space Center, National Aeronautics and Space Administration, Houston, TX, 2004.

123. "Nanostructured Polymer and Polymer Nanocomposite Membranes Exhibiting High CO_2 Selectivity," NASA Advanced Life Support Air Revitalization Workshop, University of Florida, Gainesville, FL, 2004.

122. "Nanostructure Development in and Physical Gelation of Macromolecules Induced by a Low-Molar-Mass Organic Gelator," Polymers Division, National Institute of Standards and Technology, Gaithersburg, MD, 2003.

121. "Nanostructure Development in and Physical Gelation of Macromolecules Induced by a Low-Molar-Mass Organic Gelator," Department of Chemistry, Georgetown University, Washington, DC, 2003.

120. "Emerging Uses of Polymer Nanocomposites for Catalysis and Selective Molecular Separations," 2nd International Conference on Science and Technology of Composite Materials, Mérida, Yucatán, Mexico, 2003 [plenary].

119. "Direct 3-D Visualization and Analysis of Complex Polymer Nanostructures," Max Planck Institute of Colloids and Interfaces, Golm, Germany, 2003.

118. "Morphological Studies of Nano/Mesoscale Materials," NCSU-TU International Graduate Research Training Program Workshop," Berlin, Germany, 2003.

117. "An Emerging Role for Polymer Nanocomposites: Novel Reaction Media and Separation Membranes" Science at the Edge Interdisciplinary Seminar Series, Michigan State University, East Lansing, MI,

2003.

116. "Direct 3-D Visualization and Analysis of Complex Polymer Nanostructures," Princeton Materials Institute, Princeton University, Princeton, NJ, 2002.

115. "Morphological and Property Analyses of Organogels and Hydrogels," Banner Pharmacaps, Inc., High Point, NC, 2002.

114. "Surface-Mediated Polymer Foaming in Supercritical Carbon Dioxide," American Chemical Society National Meeting, Boston, MA, 2002.

113. "Transmission Electron Microtomography of Complex Polymer Nanostructures," American Chemical Society National Meeting, Boston, MA, 2002.

112. "Microcellular Polymer Foams and Foamed Nanocomposites Generated Continuously and Batchwise in Supercritical Carbon Dioxide," Department of Chemical Engineering, McGill University, Montréal, Canada, 2002.

111. "3-D Characteristics of Complex Polymer Nanostructures," ExxonMobil Chemical Co., Baytown, TX, 2002.

110. "Morphological and Property Analyses of Nanostructured Polymer Systems," SINTEF Materials Technology, Trondheim and Oslo, Norway, 2002.

109. "Morphological and Property Analyses of Multicomponent Block Copolymer Gels," Department of Chemistry, University of Toronto, Toronto, Canada, 2002.

108. "Transmission Electron Microtomography of Complex Polymer Nanostructures," Brockhouse Institute for Materials Research, McMaster University, Hamilton, Canada, 2002.

107. "3-D Characteristics of Complex Polymer Nanostructures," Air Products & Chemicals, Inc., Allentown, PA, 2002.

106. "Multidisciplinary and Active Learning Strategies for Polymer Education in Chemical Engineering," American Institute of Chemical Engineers National Meeting, Reno, NV, 2001.

105. "Microcellular Foaming of Polymer Blends and Thin Films with Supercritical Carbon Dioxide," Department of Chemical Engineering, University of Florida, Gainesville, FL, 2001.

104. "3-D Characteristics of Complex Polymer Nanostructures," Department of Chemistry, Indiana University, Bloomington, IN, 2001.

103. "Molecular, Nanostructural and Property Considerations in Microphase-Separated Triblock Copolymer Systems," Department of Polymer Chemistry, University of Kyoto, Kyoto, Japan, 2001.

102. "Multicomponent Polymer Systems in the Presence of Supercritical Carbon Dioxide," American Chemical Society National Meeting, San Diego, CA, 2001.

101. "Volumetric Characteristics of Nanostructured Polymer Systems by Transmission Electron Microtomography," Materials Research Society National Meeting, San Francisco, CA, 2001.

100. "3-D TEM Imaging of Complex Nanostructures in Linear Multiblock Copolymers," Department of Chemical Engineering, University of Auckland, Auckland, New Zealand, 2000.

99. "Molecular, Nanostructural and Property Considerations in Microphase-Separated Triblock Copolymer Systems," Department of Chemical Engineering, University of Sydney, Sydney, Australia, 2000.

98. "Molecular, Nanostructural and Property Considerations in Microphase-Separated Triblock Copolymer Systems," Department of Chemical & Biomolecular Engineering, University of Melbourne, Melbourne, Australia, 2000.

97. "Nanostructured Polymers: A 'Big' Part of Chemical Engineering at NC State," Department of Chemical Engineering (75th Anniversary Symposium), North Carolina State University, Raleigh, NC, 2000.

96. "Multicomponent Block Copolymer Physical Gels," Freedom Scientific, West Palm Beach, FL, 2000.

95. "Bicontinuous Microstructures in Soft Condensed Matter: Evidence for Universality?" Institute for Physical Chemistry, Universität Basil, Basil, Switzerland, 2000.

94. "Glass-Coated Polymers As Next-Generation Barrier Materials: The Best of Both Worlds," American Chemical Society National Meeting, San Francisco, CA, 2000.

93. "Bicontinuous Microstructures in Soft Condensed Matter: Evidence for Universality?" Department of Chemical Engineering & Chemistry, Technische Universiteit Eindhoven and the Dutch Polymer Institute, Eindhoven, The Netherlands, 1999.

92. "Rubber Modification of Poly(methyl methacrylate) by Cryogenic Mechanical Alloying," Corporate Research Division, DSM, Geleen, The Netherlands, 1999.

91. "Bicontinuous Microstructures in Soft Condensed Matter: Evidence for Universality?" Department of Condensed Matter Physics & Chemistry and the Danish Polymer Centre, Risø National Laboratory, Roskilde, Denmark, 1999.

90. "Transparent SiO_X Thin Films as Barrier Coatings on Polymer Substrates," Toppan Printing Co., Saitama-ken, Japan, 1999.

89. "Cryogenic Polymer Blending: Challenges and Opportunities," Department of Polymer Science, Kyoto University, Kyoto, Japan, 1999.

88. "High-energy Mechanical Milling of Poly(ethylene terephthalate) and its Blends with a Liquid Crystalline Polymer," Department of Polymer Science and Engineering, Kyoto Institute of Technology, Kyoto, Japan, 1999.

87. "Effect of Monomer Sequencing on the Phase Behavior of Block Copolymer/ Homopolymer Blends" and "Novel Polymer Blends through High-Energy Mechanical Milling," Nippon Zeon Co., Kawasaki, Japan, 1999.

86. "PDLCs *vs*. PCLCs: New Challenges and Opportunities" and "Crystallization in Thermotropic Random Copolymers," National Institute of Physics, University of the Philippines at Diliman, Quezon City, Philippines, 1999.

85. "Electric- and Magnetic-Field Responsive Polymers: An Overview," ARO Workshop on Enhanced Synthesis, Processing and Properties of Materials with Electric and Magnetic Fields, John's Island, SC, 1999.

84. "Contemporary Issues Regarding Polymer Brushes and Their Mixtures," Department of Chemical Engineering/Molecular Thermodynamics Group, North Carolina State University, Raleigh, NC, 1999.

83. "Molecular Connectivity in Linear Multiblock Copolymer Networks," Department of Chemical Engineering, University of California at Berkeley, Berkeley, CA, 1999.

82. "Effect of Monomer Sequencing on the Phase Behavior of Block Copolymer/ Homopolymer Blends,"

Department of Chemical Engineering, Manhattan College, NY, 1999.

81. "Complex Phase Behavior of Linear Multiblock Copolymer Systems," Institut Charles Sadron, Université Louis Pasteur, Strasbourg, France, 1998.

80. "Correlative Morphological Studies of Block Copolymer Gels and Mesogels," Institut für Makromolekulare Chemie, Albert Ludwigs Universität Freiburg, Freiburg, Germany, 1998.

79. "Transparent SiO_X Thin Films as Barrier Coatings on Polymer Substrates," Ecole Nationale Supérieure de Chimie, Université de Haute Alsace, Mulhouse, France, 1998.

78. "Complex Phase Behavior of Linear Multiblock Copolymer Systems," Department of Macromolecular Chemistry, Institut für Polymerforschung, Dresden, Germany, 1998.

77. "Complex Phase Behavior of Linear Multiblock Copolymer Systems," Department of Chemistry, Université Pierre et Marie Curie/CNRS, Paris, France, 1998.

76. "Micellization and Bilayer Formation in ABA and ABC Triblock Copolymer Blends and Gels," Max-Planck Institut für Polymerforschung, Mainz, Germany, 1998.

75. "Effect of Monomer Sequencing on the Phase Behavior of Block Copolymer/ Homopolymer Blends," Department of Chemical & Mining Engineering and Environmental Technology, University of Bologna, Italy, 1998.

74. "Correlative Morphological Studies of Block Copolymer Gels and Mesogels," Hashimoto Polymer Phasing Project Symposium on Multicomponent Polymers and Polyelectrolytes, ERATO/JST, Kyoto, Japan, 1998.

73. "Block Copolymers: From Gels to Compatibilizers," Department of Applied Chemistry, Kansai University, Osaka, Japan, 1998.

72. "Micellization and Bilayer Formation in ABA and ABC Triblock Copolymer Blends and Gels," Department of Polymer Chemistry, Tokyo Institute of Technology, Tokyo, Japan, 1998.

71. "Novel Polymer Blends via Mechanical Attrition," Department of Physics, The University of Leeds, United Kingdom, 1998.

70. "Micellization and Bilayer Formation in ABA and ABC Triblock Copolymer Blends and Gels," Department of Physics, The University of Leeds, United Kingdom, 1998.

69. "3-D TEM Imaging of Complex Nanostructures in Linear Multiblock Copolymers," Department of Physics, University of Bristol, United Kingdom, 1998.

68. "Transparent SiO_X Thin Films as Barrier Coatings on Polymer Substrates," Department of Materials, University of Oxford, Oxford, United Kingdom, 1998.

67. "Complex Phase Behavior of Linear Multiblock Copolymer Systems," Department of Chemical Engineering, Imperial College, London, United Kingdom, 1998.

66. "Micellization and Bilayer Formation in ABA and ABC Triblock Copolymer Blends and Gels," Department of Chemistry, Katholieke Universiteit Leuven, Leuven, Belgium, 1998.

65. "Complex Phase Behavior of Linear Multiblock Copolymer Systems," Institut für Makromolekulare Chemie, Albert Ludwigs Universität Freiburg, Freiburg, Germany, 1998.

64. "Micellization and Bilayer Formation in ABA and ABC Triblock Copolymer Blends and Gels,"

Department of Physics, Cornell University, Ithaca, NY, 1998.

63. "Block Copolymers: From Gels to Compatibilizers," Department of Chemistry, University of North Carolina, Chapel Hill, NC, 1998.

62. "Solid-State Blending: A New Solution to an Old Problem?," Becton Dickinson Research Center, Research Triangle Park, NC, 1998.

61. "Solid-State Blending: A New Solution to an Old Problem?," University Seminar Program, Celanese Acetate, Charlotte, NC, 1998.

60. "Micellization and Bilayer Formation in ABA and ABC Triblock Copolymer Blends and Gels," Department of Chemical Engineering, State University of New York at Buffalo, Buffalo, NY, 1997.

59. "Micellization and Bilayer Formation in ABA and ABC Triblock Copolymer Blends and Gels," Department of Chemical Engineering, Pennsylvania State University, University Park, PA, 1997.

58. "Morphological and Property Characteristics of Triblock Copolymer Gels," 29th American Chemical Society Central Regional Meeting, Midland, MI, 1997.

57. "Effect of Midblock-Associating Additives on Midblock Bridging in Triblock Copolymers," American Physical Society National Meeting, Kansas City, MO, 1997.

56. "Facilitated Control of Block Copolymer Microstructure through *Physical* Synthesis," Borealis, Oslo, Norway, 1997.

55. "Morphological Evidence of Fluctuation-induced Localized Interactions in Disordered Block Copolymer/Homopolymer Blends," Department of Physics, University of Reading, Reading, U.K., 1997.

54. "Morphological Evidence of Fluctuation-induced Localized Interactions in Disordered Block Copolymer/Homopolymer Blends," Department of Condensed Matter Physics & Chemistry and The Danish Polymer Centre, Risø National Laboratory, Roskilde, Denmark, 1997.

53. "Complex Phase Behavior and Electron Microtomography of Nonclassical Block Copolymer Blends," Milliken Chemicals, Spartanburg, SC, 1997.

52. "Morphological and Rheological Characteristics of the Gel Phase in the Cellulose/ NH_3/NH_4SCN System," Cotton Textile Processing National Conference, New Orleans, LA, 1997.

51. "Complex Phase Behavior of Nonclassical Block Copolymer Blends and Gels," Institute of Materials Science, University of Connecticut, Storrs, CT, 1997.

50. "Phase Behavior of Ordered Diblock Copolymer Blends," International Conference on Defects in Insulating Materials – ICDIM96, Wake Forest University, Winston-Salem, NC, 1996.

49. "3-D Imaging of Non-Classical Morphologies in Block Copolymer Systems," Department of Polymer Science, University of Southern Mississippi, Hattiesburg, MS, 1996.

48. "Effect of Monomer Sequencing on the Phase Behavior of Block Copolymer/ Homopolymer Blends," Department of Chemical Engineering, George Institute of Technology, Atlanta, GA, 1996.

47. "Physical Gelation of Homo/Copolymers through the Addition of Dibenzylidene Sorbitol," Dow-Corning, Midland, MI, 1996.

46. "Effect of Monomer Sequencing on the Phase Behavior of Block Copolymer/ Homopolymer Blends,"

Dow-Corning, Midland, MI, 1996.

45. "Block Copolymer Blends: Polymer Mixtures in Confined Nanoscale Environments," Department of Physics, North Carolina State University, Raleigh, NC, 1996.

44. "Tailored Viscosity Reduction of Self-Assembled Water-Borne Polymers," McGill Pulp & Paper Research Center, McGill University and Paprican, Montréal, Canada, 1996.

43. "Control of Block Copolymer Morphology through Tailored Monomer Sequencing," Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA, 1995.

42. "Physical Gelation of Polydimethylsiloxane Homopolymer and Graft Copolymers with DBS," Milliken Chemicals, Spartanburg, SC, 1995.

41. "Polymer Surface Characterization with X-ray Microscopy," Workshop on Materials Characterization with IR and Soft-X-ray Microscopy at the Duke Free Electron Laser Laboratory and at NCSTAR, Duke University, Durham, NC, 1995.

40. "Block Copolymer Gels: A New Family of Smart Materials," North Carolina Materials Research Society Section, MCNC, Research Triangle Park, NC, 1994.

39. "Strongly-Segregated Block Copolymer Blends Possessing Non-Classical Morphologies: A 3-D Imaging Study," National Institute of Standards and Technology, Gaithersburg, MD, 1994.

38. "Strongly-Segregated Block Copolymer Blends Possessing Non-Classical Morphologies: A 3-D Imaging Study," Becton Dickinson, Research Triangle Park, NC, 1994.

37. "Intra-Microdomain Mixing in Block Copolymers: A Self-Consistent Field Analysis," Hoechst-Celanese/University of North Carolina Polymer Symposium, Chapel Hill, NC, 1994.

36. "Morphological Characteristics of Linear $(AB)_n$ Multiblock Copolymers near the Order-Disorder Transition," Microscopy Society of America National Meeting, New Orleans, LA, 1994.

35. "3-D Imaging of Ordered Block Copolymer Blends," National Center for Electron Microscopy, Lawrence Berkeley Laboratory, Berkeley, CA, 1994.

34. "Self-Assembly of Block Copolymers: A Conformational Study," Department of Physics, University of North Carolina, Chapel Hill, NC, 1994.

33. "XPSM Studies of Heterophase Polymer Surfaces and Polymer-Coated Fibers," Procter & Gamble Co., Cincinnati, OH, 1994 (University Exploratory Research Program Competition semifinalist).

32. "3-D Imaging of Strongly-Segregated Block Copolymer Blends," Shell Development Co., Houston, TX, 1993.

31. "3-D Imaging of Strongly-Segregated Block Copolymer Blends," Exxon Research and Engineering Co., Annandale, NJ, 1993.

30. "Electron Tomography of Microstructural Elements in Strongly Segregated Block Copolymers," Microscopy Society of America National Meeting, Cincinnati, OH, 1993.

29. "Effect of Block Copolymer Architecture and Chain Length on Molecular Mixing in Copolymer/Homopolymer Blends," Raychem Corp., Menlo Park, CA, 1993.

28. "Effect of Block Copolymer Architecture and Chain Length on Molecular Mixing in Copolymer/Homopolymer Blends," Hoechst-Celanese Corp., Summit, NJ, 1993.

27. "Effect of Block Copolymer Architecture and Chain Length on Molecular Mixing in Copolymer/Homopolymer Blends," Allied-Signal Inc., Morristown, NJ, 1993.

26. "Phase and Conformational Behavior of Strongly-Segregated $(AB)_n$ Multiblock Copolymers," Department of Materials Science and Engineering, University of Washington, Seattle, WA, 1993.

25. "Morphological Studies of Block Copolymers and Their Blends," North Carolina Section, American Chemical Society Polymer Discussion Group, Raleigh, NC, 1993.

24. "Morphological Studies of Block Copolymers," Air Products and Chemicals, Inc., Allentown, PA, 1992.

23. "Morphological Studies of Novel Block Copolymers and Block Copolymer Blends," Department of Chemistry, University of North Carolina, Chapel Hill, NC, 1992.

Prior to North Carolina State University

22. "Statistical Thermodynamics of Multiblock Copolymers in the Strong-Segregation Limit: A Confined Chain Approach," Department of Chemical Engineering, University of California, Irvine, CA, 1992.

21. "Morphological Studies of $(AB)_n$ Block Copolymers and Their Blends," Department of Polymer Science and Engineering, University of Massachusetts, Amherst, MA, 1992.

20. "Morphological Studies of $(AB)_n$ Block Copolymers and Their Blends," Department of Materials Science and Engineering, North Carolina State University, Raleigh, NC, 1991.

19. "Morphological Studies of $(AB)_n$ Block Copolymers and Their Blends," Department of Macromolecular Science, Case Western Reserve University, Cleveland, OH, 1991.

18. "Morphological Studies of $(AB)_n$ Block Copolymers and Their Blends," Department of Materials Science and Engineering, Pennsylvania State University, University Park, PA, 1991.

17. "Electron Microscopy of the Crystalline Structure in Thermotropic Random Copolymers," Electron Microscopy Society of America National Meeting, San Jose, CA, 1991.

16. "Can Block Copolymers Elucidate Colloidal Structure?" Cincinnati Section, American Chemical Society, Covington, KY, 1991.

15. "Imaging of Crystalline Structure in Thermotropic Random Copolymers," Department of Chemical Engineering, University of Cincinnati, Cincinnati, OH, 1990.

14. "Imaging of Crystalline Structure in Thermotropic Random Copolymers," Department of Chemical and Metallurgical Engineering, Wayne State University, Detroit, MI, 1990.

13. "Imaging of Crystalline Structure in Thermotropic Random Copolymers," Institut Charles Sadron, Université Louis Pasteur, Strasbourg, France, 1989.

12. "Imaging of Crystalline Structure in Thermotropic Random Copolymers," Max-Planck Institute for Polymer Research, Mainz, Federal Republic of Germany, 1989.

11. "Imaging of Crystalline Structure in Thermotropic Random Copolymers," Polymer Department, Risø National Laboratory, Roskilde, Denmark, 1989.

10. "SANS of Microphase-Separated Poly(siloxane-imide) Segmented Copolymers," Norsk-Hydro, Porsgrunn, Norway, 1989.

9. "SANS of Microphase-Separated Poly(siloxane-imide) Segmented Copolymers," Dyno Industries, Lillestrøm, Norway, 1989.

8. "Electron Microscopy of Crystalline Structure in Thermotropic Random Copolymers," Department of Physics, University of Oslo, Oslo, Norway, 1989.

7. "Crystallization in Thermotropic Random Copolymers," E.I. Du Pont de Nemours & Co., Wilmington, DE, 1989.

6. "Microstructural Characterization of Siloxane-imide and Styrene-butadiene Block Copolymers," General Electric Company, Schenectady, NY, and Pittsfield, MA, 1988.

5. "Microstructural Characterization of Siloxane-imide and Styrene-butadiene Block Copolymers," The Procter & Gamble Co., Cincinnati, OH, 1988.

4. "Diversity in Chemical Engineering: Application to Polymer Science," Pennsylvania State University, Schuylkill Campus, Schuylkill Haven, PA, 1988.

3. "Microstructural and Bulk Characterization of Two Poly(siloxane-imide) Multiblock Copolymers" and "Microstructural Response of SiIm and SBS Block Copolymers to Heat Treatment," DOW Chemical, Freeport, TX, 1988.

2. "The Interphase Composition Profile in SB/SBS Block Copolymers, Measured with Electron Microscopy, and Microstructural Implications," American Chemical Society National Meeting, New Orleans, LA, 1987.

1. "An Introduction to Block Copolymer Thermodynamics" and "The Role of the Interphase Composition Profile in SB/SBS Block Copolymers," Departments of Chemical Engineering, University of the Philippines, Los Baños and Diliman Campuses, Philippines, 1986.

Recent Achievements of **Professor Richard J. Spontak** (**North Carolina State University**):

Water-Activated Functional Polymers to Meet Global Challenges

The human race is presently experiencing various global challenges ranging from environmental changes to geopolitical upheaval, and Professor Spontak has successfully applied his expertise and skill regarding the design and processing of soft materials to specifically address two that are particularly worrisome and worsening: infectious disease proliferation and global climate change. While these topics appear to be unrelated, Professor Spontak has developed new classes of water-activated functional materials that can mitigate these challenges to improve the welfare of humanity. His accomplishments are described below.

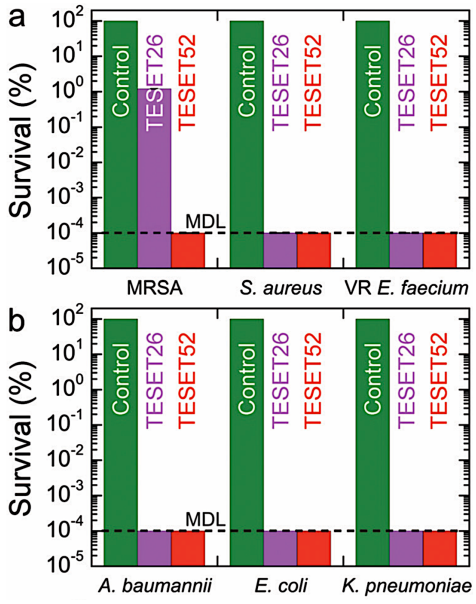
A. Fast-acting, broad-spectrum, continuously self-disinfecting polymer surfaces

Motivation: Potentially harmful microbes such as bacteria and viruses that adhere to surfaces are routinely transmitted to new hosts, thereby promoting the proliferation of infectious organisms. Nosocomial infections are estimated by the U.S. Centers for Disease Control and Prevention (CDC) to affect 1 out of every 20 hospitalized patients nationally, thereby causing about 100,000 deaths each year (which exceeds the number of deaths by breast and prostate cancer combined) and placing an enormous financial burden on the national healthcare system. Common hospital-acquired infections (HAIs) include surgical site infections (33.7%), ventilator-associated pneumonia (31.6%), bloodstream infections (18.9%), *Clostridioides difficile* (*C. difficile*) infections (15.4%), and catheter-associated infections (0.4%), where the percentages indicate how hospitals in the U.S. spent $9.8 billion to treat such infections. While surgery-related infections are prone to develop exclusively in hospitals, the others are widespread among the elderly who, because they suffer from generally poor health and compromised or weakened immune systems, are restricted to living in nursing homes or other assisted-living facilities. Under these conditions, microbes adhere to numerous surfaces (e.g., linens, drapes/blinds, monitoring equipment, and countertops) where they are able to remain dormant for extended periods of time. After they come in contact with (and are transmitted to) a patient, they proliferate and ultimately induce infection. If this growing health concern is not daunting enough, some of these infections are no longer treatable by available medication. Antimicrobial resistance (AMR) constitutes a particularly troublesome development, emerging as a threat to human health around the globe, as evidenced by the worldwide distribution of methicillin-resistant *Staphylococcus aureus*, frequently referred to as MRSA. Bacterial strains such as MRSA and vancomycin-resistant *Enterococcus faecium*, popularized as "nightmare bacteria" or "superbugs" by the media, are responsible for over 700,000 deaths annually worldwide due to their evolutionary resistance to last-resort antibiotics. An increase in pathogens exhibiting AMR not only distresses the general public but also challenges the healthcare industry. Relatively few innovative antibiotics have been recently identified (over the past 20 years or so), whereas AMR has steadily increased. Predictions from a study in the U.K. indicate that, because of rising AMR, current antibiotics will become unable to treat many bacterial infections by 2050, resulting in ~10 million deaths globally each year (for comparison, the annual number of deaths due to cancer in 2050 is predicted by the CDC to be ~2.3 million in the U.S.). While HAI and related infections represent a ***chronic*** global challenge, epidemics and pandemics such as COVID-19 introduce ***acute*** challenges that greatly confound the function of society, industry, governments, and economies, as well as amass substantial loss of life. Since existing drug-based treatments are anticipated to lose much of their effectiveness against pathogens in the future due to a continuing worldwide increase in AMR and viral infections rely on the production of catch-up vaccines that can become ineffective due to evolutionary mutations (e.g., the SARS-CoV-2 Omicron BA.5 subvariant), numerous efforts have sought to adopt a more prevention-oriented approach wherein microbes are eradicated prior to transmission, proliferation and infection. These strategies typically provide point-in-time disinfection (e.g., bleach or UV radiation) that must be manually repeated, rely on additives (e.g., metal nanoparticles) that can contaminate the environment (including the food chain) and gradually lose toxicity, or introduce chemical groups that only target one class of microbes (instead of being broad-spectrum).

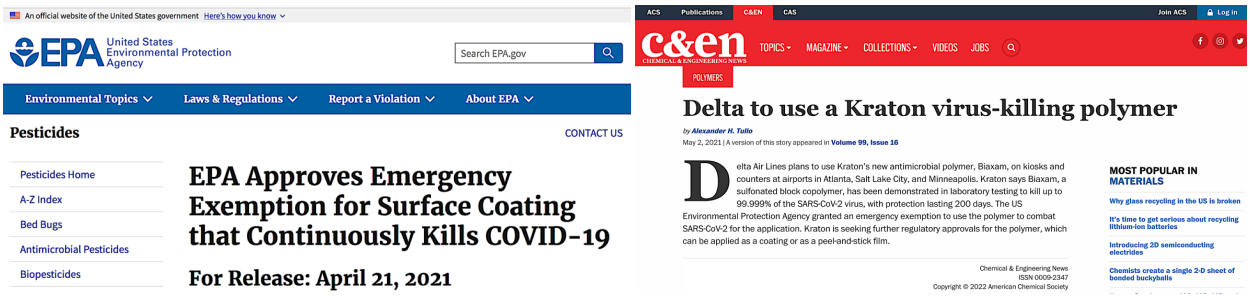
Solution: Although Professor Spontak has been actively involved in the development of broad-spectrum antimicrobial polymers and polymer coatings capable of photodynamically inactivating antibiotic-resistant Gram-positive/negative bacteria, viruses and fungi in collaboration with an interdisciplinary research team at NC State University (*ACS Appl. Mater. Interfaces*, **2018**, **2021**; impact factor = 10.4), the focus here is

on his discovery of an entirely new and unexplored microbiocidal strategy. The use of ***cationic*** polymers alone or with metal (oxide) additives has long been established as a means by which to kill bacteria due to their inherently negatively-charged encapsulating membrane, but Professor Spontak observed that, upon hydration, insoluble ***anionic*** polymers alone could kill not only a wide range of Gram-positive/negative bacteria (including antibiotic-resistant MRSA), but also several viruses (including human adenovirus and influenza), as reported in *Mater. Horiz*. (**2019**; impact factor = 15.7). The mechanism by which such broad-spectrum inactivation occurs reflects the synergy between two independent factors: (1) the water-insoluble polymers are nanostructured block polymers possessing hydrophilic nanochannels (due to the presence of sulfonic acid) embedded in a hydrophobic matrix, and (2) protons from the sulfonic acid groups migrate through the hydrophilic channels to the surface of the hydrated polymers and drastically lower the surface pH to below 1.0. This unique "pH-drop" mechanism on the surface of polymer films or coatings is unlike any other antimicrobial mechanism and is completely different from the mechanism by which anionic polymers function when fully dissolved in aqueous solution. This highly acid aqueous contact layer exists at nanoscale dimensions and is undetectable by touch. While some microbes are capable of withstanding low-pH environments, most pathogenic microbes are not and completely dissolve in the acidic layer without any chemical targeting. The fact that this inactivation mechanism is non-selective indicates that microbes will not be able to develop AMR in the future. Professor Spontak has also established that this mechanism is equally effective against human coronaviruses such as SARS-CoV-2 and HCoV-229E, as well as CDC urgent threats *C. difficile* (bacteria) and *C. auris* (fungi), and that the mechanism is general insofar as the amphiphilic polymer possesses contiguous hydrophilic nanochannels to permit the diffusion of protons from sufficiently strong acidic moieties to generate a highly contact layer (*Adv. Sci*., **2021**; impact factor = 17.5).

Performance: The ability of different anionic polymers to inactivate different microbes is determined from the population of live microbes (or uninfected host cells) observed at different suspension dilutions, in strict accord with established measurement protocols. The initials of the 6 Gram-positive/negative bacteria primarily responsible for HAIs yield the ***ESKAPE*** acronym, and 5 of those (excluding MRSA) are displayed in the bacterial survival plots to the right. Included are results collected from 2 polymers (TESET26 and TESET52) differing in their degree of sulfonation (in mol%). With TESET52, all bacteria in buffered aqueous suspensions are killed to the minimum detection limit (MDL = 99.9999+%) after an exposure time of just 5 minutes. Likewise, enveloped and non-enveloped viruses, as well as the SARS-CoV-2 virus, all reach the MDL in 5 minutes, whereas the more acid-resistant HCoV-229E strain requires 20 minutes to reach the MDL. New results reveal that CDC urgent threat *C. difficile* in the vegetative (infectious) state are killed to 99.99999+% in 5-10 minutes, depending on the strain. Similarly, the gastrointestinal fungi *C. albicans* and C. auris are likewise fully inactivated upon exposure to TESET52.



Applicability: Professor Spontak has filed for a U.S. patent on this breakthrough technology, which is exclusively licensed to Kraton Corporation (purchased by DL Chemical). It received emergency approval by the EPA in 2021 for use by Delta Air Lines in domestic terminals (see below for associated headlines).



B. Ultraselective carbon-capture membranes aimed at reducing CO_2 emissions

Motivation: Global climate change constitutes one of the increasingly dire challenges presently faced by humanity, since it is already attributed to several deleterious consequences, for instance, the accelerated melting of the polar icecaps, uncontrollable wildfires on different continents, irreparable damage to coastlines and coastal ecosystems, and severe storm and unpredictable weather patterns that greatly endanger inhabited regions. The atmospheric emission of greenhouse gases, such as carbon dioxide (CO_2), is deemed primarily responsible for this growing worldwide problem, and the Intergovernmental Panel on Climate Change has reported that CO_2 emissions in particular must be reduced (by ≈ 45%) by 2030 relative to 2010 to limit the increase in global temperature to 1.5 °C beyond that measured before the industrial revolution. Current CO_2 emissions from power plants and factories account for ≈ 65% of all greenhouse gases, and the current level of atmospheric CO_2 has been recently reported to reach its highest all-time level at 419 ppm, in which case continued development of technologies related to carbon capture (CC) and storage is needed to reduce CO_2 emissions worldwide. Although already commercially available for CC technologies, chemical absorption methods that rely exclusively on various amine compounds typically suffer from high operating costs and the possibility of health or environmental dangers. An established CC alternative to chemical absorption derives from polymer gas-separation membranes that can be chemically tailored to achieve different levels of CO_2 selectivity and permeability. Crosslinked elastomeric membranes produced from polyethers, such as the ones introduced by Professor Spontak for CO_2 removal from H_2 nearly 20 years ago (*Adv. Mater.*, **2003**; impact factor = 32.1), are reverse-selective, which means that their selectivity is based on solubility rather than size (*i.e.*, diffusion) considerations, and display a strong chemical affinity for CO_2. Glassy polymers such as polyacetylenes, on the other hand, typically operate on the basis of size-sieving but can actually be made reverse-selective via addition of nanoparticles, as previously demonstrated by Professor Spontak (*Science*, **2002**; impact factor = 63.7), to enlarge the free-volume pathways through which penetrant gas molecules move. Critically important considerations here are material effectiveness (in terms of both CO_2 ***selectivity*** – separation quality – and ***permeability*** – throughput), cost, processability, scalability, and durability. Simultaneously meeting all these requirements has proven to be an arduous task, despite the numerous materials strategies proposed.

Solution: While a wide range of carbon-capture efforts are continuously being developed around the world to help mitigate the adverse effects of global climate change, advances in membrane technologies that combine greatly improved CO_2 separation efficacy with low cost, facile fabrication, upscaling and implementation, and mechanical robustness are still needed. In his latest study (*Science*, **2022**), Professor Spontak introduced a hybrid-integrated (**HI**) membrane strategy wherein a high-permeability thin film is chemically functionalized with a highly CO_2-philic patchy surface layer. This nanofabrication scheme is based on a low-diffusivity, high-solubility mechanism that relies on substantial enrichment of CO_2 in the surface layer naturally hydrated by the water vapor present in all targeted gas streams, followed by fast CO_2 transport through a supported thin film of a highly permeable polymer. Since this design employs commercial polymer thin films (PTFE AF and PDMS) that are already available for gas separations, these new membranes can immediately be produced, upscaled and put into field operation after surface functionalization, achieved by controllably growing relatively short, amine-modified chains from the polymer surface. Spectroscopic methods and microscopy confirm the existence of the amine surface layer, which also serves to enhance surface roughness and, thus, separation area. Multilayer HI membranes prepared in this fashion are not diffusion-limited and, in some cases, are able to retain much of their inherently high CO_2 permeability while their CO_2 selectivity is increased in some cases by over ~150x, far exceeding the upper bound that reflects the trade-off between gas permeability and selectivity often encountered with polymer membranes intended for gas separations.


National Science Foundation

Science Topics News &

Research News

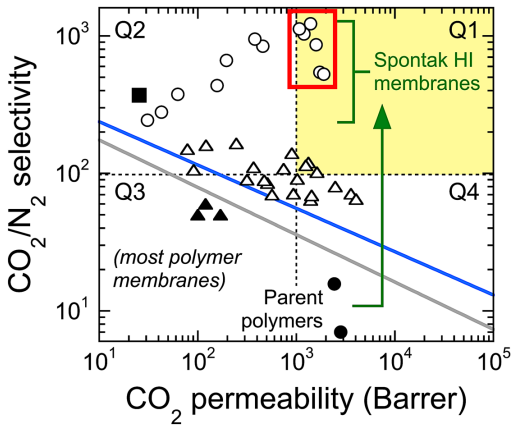
New polymer membrane technology efficiently removes carbon dioxide from mixed gases

Advance could reduce emissions and help combat climate change

May 2, 2022

A group of researchers at North Carolina State University working under a grant to the North Carolina Research Triangle Nanotechnology Network, a site of the NSF National Nanotechnology Coordinated Infrastructure program, has developed a polymer membrane technology that removes carbon dioxide from mixed gases. It could play a role in reducing power plant emissions.

Performance: The performance of HI membranes relative to other polymer membranes intended for CO_2 separation can be assessed through the use of a so-called Robeson plot, which evaluates membrane performance in terms of selectivity as a function of permeability. This routine representation identifies the empirical upper bound that reflects the trade-off between selectivity and permeability: a higher permeability is generally accompanied by a lower selectivity and vice-versa. Previous and more recent empirical upper bounds are identified as the lines in the figure to the right. To provide a classification scheme for these performance metrics, we divide the Robeson plot into quadrants (Q1 – Q4, labeled) and classify membranes exhibiting CO_2 permeabilities in excess of 10^3 Barrer as ***ultrapermeable*** (**uP**) and membranes achieving CO_2/N_2 selectivities greater than 10^2 as ***ultraselective*** (**uS**). While many membranes are uP in Q4, few are uS. Examples of uS membranes in Q2 are cellulose nanofiber/ionic liquid membranes (which, as Professor Spontak recently reported [*Green Chem.*, **2020**: impact factor = 10.2], rely on hydrophilic nanochannels that promote the transport of CO_2 by combining improved solubility and size sieving upon hydration) and Professor Spontak's new amine-modified HI membranes, as well as a handful of polyether-based copolymers detailed in the literature. Few membranes are, however, classified as uP and uS in Q1 (the Goldilocks [yellow] quadrant): a bioinspired thin film and membranes incorporating graphene oxide nanosheets perform at low selectivity levels, whereas Professor Spontak's amine-modified membranes are clearly uP and uS in Q1. Although surface amination of the parent uP membranes noticeably reduces their CO_2 permeability, the corresponding increase in CO_2/N_2 selectivity is ~150x (~15,000%) greater, resulting in record-breaking selectivity levels. These results acquired from "mixed-gas" measurements to account for CO_2 plasticization confirm that the patchy surface amine layer grown on uP membranes provides a highly CO_2-philic environment that concentrates and transports CO_2 molecules via facilitated transport while the underlying polymer substrate and support provide unobstructed pathways for fast diffusion (to achieve concurrent uS and uP performance). Results obtained for CO_2/N_2 mixtures from power-plant flue gas are similarly observed in the case of CO_2/CH_4 mixtures for "methane sweetening," which aims to improve the fuel efficiency of natural gas obtained from underground and livestock sources.



*Performance metrics of Spontak HI amine-modified membranes (open circles) relative to their parent (unmodified) polymers (filled circles), as well as other polymer membranes that are considered very promising for CO_2 capture (open triangles). Many membranes are designed to be uP with CO_2 permeabilities beyond 10^3 Barrer in Q4. In Q2, uS membranes such as those based on nanocellulose/ionic liquid (filled square) reach CO_2/N_2 selectivities over 10^2 at low CO_2 permeability levels. The Goldilocks quadrant (Q1, yellow) reflects both uP and uS performance. The record-breaking Spontak HI membranes in Q1 are highlighted for emphasis (red box). Examples of **commercial** polymer membranes for carbon capture are also included (filled triangles) for comparison. Solid lines identify the permeability-selectivity tradeoff reported by Robeson for various polymer membranes (gray) and more recently for uP membranes (blue).*

Applicability: Although the primary focus in developing these amine-modified membranes is on industry-relevant carbon-capture from flue gas (to reduce CO_2 emissions), biogas upgrading and natural-gas sweetening, membrane-based separation designed for CO_2 removal also possess enormous potential in other fields: artificial lungs for CO_2 extraction from blood, ventilators for CO_2 removal from the exhaled breath of patients with compromised lung capacity, aquaculture systems for targeted removal of dissolved CO_2 at toxic levels in water, food fermentation processes for the preservation of aroma (*e.g.*, wine), and aeronautics and space technologies for scrubbing environmental air in spatially confined extraterrestrial vehicles or stations. All these applications possess one characteristic in common: a low CO_2 level, which introduces significant and economic challenges for CO_2 removal via conventional separation means. Low-cost and scalable separation processes that employ uP and uS membranes such as the ones Professor Spontak developed are highly preferable to chemical CO_2 absorption technology that can be unsuitable due to toxicity concerns, apparatus size, environmental contamination, or prohibitive cost. Since the support polymer membranes employed in his pioneering work (e.g., PTFE AF) are already incorporated in existing membrane-based separations, they only require a relatively facile surface modification to become uP and uS for important CO_2-related removal processes to benefit both the environment and healthcare.

Overview of Teaching/Mentoring Achievements

Personal Philosophy

- Teaching is an incredibly rewarding responsibility. The opportunities we, as teachers, have to impart knowledge and experience to our students, to help them become productive members of society, and to assist in their personal and professional development are limited only by our own creativity. Stepping into a classroom and seeing students who are eager to learn is exhilarating and spurs a receptive teacher to go above and beyond the call of duty. The important message here is to *make* students of any age or background enthusiastic about learning. To achieve this, I apply my principles of **ITEACH**: **I**ntegrity, **T**ruth, **E**xcellence, **A**ctivation, **C**hallenge and **H**ospitality. Integrity is responsible for shaping the future of society. Truth is the cornerstone of education and of our society as a whole. Excellence must be emphasized so that students realize its importance in everything the students pursue. Activation requires students to become fully engaged in their learning environment. Challenge provides an impetus to grow and promotes lifelong learning. Hospitality refers to the ability of instructors to make students always feel welcome and respected.

Teaching/Mentoring Effectiveness

- Received average student ratings of 4.62/5.00 (instructor effectiveness) and 4.48/5.00 (course quality) for 859 (under)graduates taught on-campus and by distance learning since 2011.
- Selected to mentor 4 Park Scholars, 4 Goodnight Scholars and 1 Beckman Scholar in my research laboratory, and to serve on the Goodnight Scholars Advisory Board.
- Mentored 8 award-winning senior design teams, with one interdisciplinary team winning 1st Place ($15,000) in a DoE-sponsored Energy Challenge by building a hang-glider from cardboard and flying it at Kitty Hawk, NC, on the 100th anniversary of the Wright Brothers' historical flight.
- Mentored visiting students from China, Turkey and Saudi Arabia, and graduate students from Norway, Germany, Japan, Thailand, and Australia. Certified to teach Mental Health First Aid.
- Developing an on-line M.S. degree program regarding Peace and Global Engineering to prepare students to enter into government and non-profit sectors and address international challenges.

Professional Recognition

- Received the COE/Alumni Association Outstanding Teaching Awards (inducted into the Academy of Outstanding Teachers), the Blessis Advising Award, the Alumni Distinguished Undergraduate and Graduate Professorships, and the Board of Governors' Award for Teaching Excellence.
- Received the International Network for Engineering Education & Research Recognition Award and the American Society for Engineering Education (Southeast Region) Outstanding Mid-Career Teaching Award, and the *Tau Beta Pi* Engineering Honor Society McDonald Mentor Award.
- Received a Fulbright Senior Specialist Award and an ERASMUS Award to teach and provide curricular guidance at Istanbul Technical University and the Middle East Technical University.
- Invited to deliver short courses on polymer science and electron microscopy at the Humboldt University, Peking University, Tsinghua University, Beijing Inst. of Technol., Norwegian University of Science & Technol., University of Warsaw, University of Mainz, & Adam Mickiewicz University.
- Invited to teach short courses on functional TPEs annually for the ACS (RUBB Division) and SPE.

Instructional Methods

- Introduced literature critiques and mock patent litigations to deepen knowledge and improve skills.
- Promoted in-class demonstrations and videos to augment classroom learning (an early example is posted at www.youtube.com/watch?v=kCvfipaF2qk). The videos have evolved to include accounts of "thermodynamic heroes," *e.g.*, historical figures, as well as living faculty (such as S. Glotzer at U. Michigan). Undergraduates interview "famous" engineering faculty around the world.
- Conducted off-campus field trips (some of which yielded internships or employment) for students at polymer-related industrial facilities around the state, and incorporated my research in classes.
- Recorded lectures to augment in-class lectures 6 years ***before*** the COVID-19 pandemic.
- Introduced mid-semester instructor/exam evaluations since the 1990s to improve effectiveness.
- Provide optional problem/review sessions and require 5' student talks on course-related contemporary topics for students to learn to critically evaluate the validity of articles in the popular press.

Selection of Anonymous Student Comments

"Dr. Spontak has been the best professor I have had at NC State. His enthusiasm for what he does shines clearly through his teaching. In turn, this inspires a desire to learn from the students which in the end means that we learn more broadly and deeply than in a normal class. Bravo, Dr. Spontak!"

"*Dr. Spontak is the first professor that I have had at this university who actually cares about more than a grade. He probably spent more time teaching and with review sessions than most people spend in studying. He cares about more than the class: if you go in and talk to him, he is down to earth and helps you see the big picture for the future. He is one of the top teachers I have ever had.*"

"Dr. Spontak is an excellent instructor who possesses great knowledge and understanding of the course material, and did an excellent job of imparting that knowledge to the students. What truly amazed me was his willingness to help the students. Of all the teachers I have encountered in my three years of college, Dr. Spontak has made himself the most accessible to answer any questions that the students had, and did so with eagerness and courtesy, so the students realized he really cared. He is truly an outstanding teacher."

"You are the best instructor I've had in college (and that is saying a lot considering that I've had Dr. Velev, Dr. Khan, and Dr. Bullard teach some of my classes). I really appreciate how you incorporate your knowledge from industry and research into the class material. This makes the material more engaging because I feel like I might actually draw on this knowledge in the future."

"Dr. Spontak is an excellent and enthusiastic lecturer. He conveys the topic well and actively encourages thinking about the topic. I highly recommend this course to anybody interested in polymers. Truthfully, I entered the course with no particular interest (only to fulfill a major requirement) but left with a deeper appreciation of the topic and a greater interest in this technology."

"Without a doubt, you have been the best professor I have had at N.C. State...in engineering courses or otherwise. You always kept the class interested and always made sure that you explained everything so that everyone could understand. On top of all that, you treat students fairly and are friendly enough to make yourself approachable without compromising professionalism."

"*Spontak is ALWAYS helpful; the tests are always fair; Spontak's instructions were always clear. I feel that Dr. Spontak is one of the best, if not <u>the</u> best, instructors I have ever had. He goes above and beyond the call of duty to assist students, always putting the student first. He is a wonderful teacher.*"

"Dr. Spontak is the most outstanding teacher whom I have ever seen. I enjoyed his lectures very much. I wish there'll be more courses that can be taught by Dr. Spontak."

"Dr. Spontak is a great professor. He really cares about students and even devotes extra time outside of class to have a problem session each week. You can tell he wants us to learn the material, which shows during class and in the amount of effort he puts into his class and to teaching. He makes the material interesting and explains why it is useful knowledge for us to have. I have learned a lot in this class!"

"He was an excellent professor. He cares very deeply about his students, and about the lecture material. He was very enthusiastic in lecture, something that made thermodynamics much more bearable. I wasn't a fan of his corny humor at the beginning of the semester, but by the end of the course I grew to enjoy it. His problem sessions were exactly what I needed to understand the lecture content. I loved that he emphasized knowledge of concepts over mindlessly working problems."

"*This instructor is THE best I've ever had. He has an inexhaustible knowledge of the material in this course, plus, unlike most other professors, he has a genuine interest and caring for how his students are progressing. He makes himself available during times other than his designated office hour[s], and gives a 'grading' sheet after each exam to see how the students felt about the exam and his teaching ability. He is a professor that I will recommend to my friends, no matter what materials class they are taking.*"

"Thank you for being such a great chemical engineering professor. The way you ran your class made chemical engineering and thermodynamics truly come alive. You were always open to questions and discussion from students and did all you could so that we could succeed and really understand the material. The passion you have for it was truly passed down to all of us!!"

"LOVE DR. SPONTAK. BEST TEACHER EVER!!!! He makes you work for the grade but it is one of the best classes I have taken here at State."

"Dr. Spontak is god tier when it comes to teaching."

[These comments are collected from end-of-semester class evaluations that are available for verification.]

Service and Outreach Activities

NC State University

Member	Honorary Doctorate Committee	2022-
Committee Chair	Student Graduation Speaker Committee	2022
Certified Instructor	Mental Health First Aid Initiative	2021-
Elected Member	UNC Faculty Assembly	2020-22
Founding Member	Center for Adv. Virus Experimentation	2020-
Member	College Promotion/Tenure Committee	2020-22
Member	Faculty Hearing Committee	2019-23
Faculty Co-advisor/Advisor	*Tau Beta Pi* Honor Soc. Student Chap.	2019-
Department Committee Chair	Exceptional TA Award Committee	2016-
Delegate to Australia	University Global Partnership Network	2016
Goodnight Scholars Advisory Committee	Goodnight Scholars Program	2015-
Faculty Co-advisor	SPE Student Chapter	2013-
Elected Member	University Faculty Senate	2012-16
Member	Intellectual Property Committee	2011-
Associated Faculty Member	The Nonwovens Institute	2009-
Department Committee Chair	Peer Evaluation of Teaching Committee	2008-24
Chair	Academic Misconduct Inquiry Board	2006-08
Faculty Co-advisor (inaugural)	MRS Student Chapter	1998-00
Director of Graduate Admissions	CBE Department	1999-03

External

Editor-in-chief	*J. Encapsulation & Adsorption Sci.*	2014-
Editor-in-chief	*Journal of Advanced Mechanical Eng.*	2011-12
Editor-in-chief	*Open Colloid Science Journal*	2008-12
Co-editor-in-chief	*Open J. Organic Polymer Materials*	2011-
Annual Editor-in-chief	*Innovations in Mater. Sci. & Eng.*	2013-14
Associate Editor	*Open Chemistry Journal*	2014-21
Associate Editor	*Advances in Nano Research*	2020-
Editorial Advisory Board	*Scientific Reports*	2023-
Editorial Advisory Board	*ACS Sustainable Chemistry & Eng.*	2021-
Editorial Advisory Board	*Int. Journal of Molecular Sciences*	2020-
Editorial Advisory Board	*Coatings*	2020-
Editorial Advisory Board	*Polymers*	2020-
Editorial Advisory Board	*Journal of Chemical & Process Eng.*	2014-
Editorial Advisory Board	*Chemical Eng. & Process Techniques*	2013-
Editorial Advisory Board	*Nanomaterials and Nanoscience*	2013-
Inaugural Editor-in-chief	*Soft Nanoscience Letters*	2010-14
Editorial Advisory Board	*Langmuir* (ACS)	2008-10
Editorial Advisory Board	*International Journal of Polymer Sci*.	2008-
Editorial Advisory Board	*Open Macromolecules Journal*	2007-
Editorial Advisory Board	*Macromolecules* (ACS)	2003-05
Inaugural Editorial Advisory Board	*Materials Today*	2002-07
Editorial Advisory Board	*Macromolecular Rapid Commun.*	2001-18
Editorial Advisory Board	*Macromolecular Chemistry & Physics*	2001-18

Elected Director, Blue Ridge Rubber Group	American Chemical Society (Rubber)	2021-23
Elected Director/President	*Tau Beta Pi* RTI Professional Chapter	2021-23
Elected Director, North Carolina Chapter	Fulbright Association	2023-
Selected Senior Specialist Award Reviewer	Fulbright Association	2019-
Advisory Board Member, Carbon Neutral Tech Center	Sichuan University, China	2021-
Executive Committee (liaison with Rubber Division)	ACS PMSE Division	2023-
Guest Co-Editor	*Materials Research Society Bulletin*	2006
Elected Alternate Councilor/Senior Chemists Chair	North Carolina ACS Chapter	2024