RICHARD J. SPONTAK

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Professional Preparation

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

Professional Experience

2016 – present	Distinguished Professor, NC State University
2015 – present	Alumni Distinguished Graduate Professor, NC State University
2012	Lars Onsager Professor, Norwegian University of Sci. & Technol. (Norway)
2002 – present	Professor of Chemical & Biomol. Eng. & Mater. Sci. & Eng., NC State Univ.
2001 – present	Alumni Distinguished Undergraduate Professor, NC State University
1997 – 2002	Associate Professor of Chem. Eng. and Mater. Sci. & Eng., NC State Univ.
1992 – 1997	Assistant Professor of Materials Science & Engineering, NC State University
1989 – 1992	Staff Scientist, Corporate Research Division, Procter & Gamble, Cincinnati
1989	Research Fellow, Institutt for Energiteknikk, Kjeller (Norway)
1988 – 1989	Research Associate, University of Cambridge, Cambridge (United Kingdom)
1983 – 1988	Graduate Student Research Assistant, Lawrence Berkeley National Lab

Awards & Honors of Distinction

60th Birthday Websymposium on Advanced Materials	Int. Assoc. of Advanced Materials	2021
International Award	Society of Plastics Engineers	2015
Elected Member	Norwegian Academy of Technol. Sci.	2015
Elected Fellow	Royal Society of Chemistry	2015
Fulbright Senior Specialist Award	IIE CIES[1]	2014
Lars Onsager Professorship and Medal	Norwegian Univ. Sci. and Technol.	2012
Alumni Fellow Award	Pennsylvania State University	2012
Alcoa Distinguished Engineering Research Award	NC State College of Engineering	2012
Colwyn Medal	Inst. of Materials, Minerals & Mining	2011
Elected Fellow	Inst. of Materials, Minerals & Mining	2011
Chemistry of Thermoplastic Elastomers Award	American Chemical Society (Rubber)	2008
Board of Governors' Award for Excellence in Teaching	University of North Carolina	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
Outstanding Research Award	NC State Alumni Association	2005
Alcoa Foundation Research Achievement Award	NC State College of Engineering	1996
Outstanding Research Achievement Award	*Sigma Xi* Research Honor Society	1995

Other Awards & Honors

North Carolina State University

Advisory Board Member, Carbon Neutron Tech Center	Sichuan University, China	2021-
Albert Nelson Marquis Lifetime Achievement Award	Marquis *Who's Who*	2020
Named Fellow	Int. Association of Advanced Materials	2020

[1] Institute of International Education Council for the International Exchange of Scholars

Momentive EX1005
U.S. Patent No. 12,337,057

Global Oil and Gas Award Finalist	Institution of Chemical Engineers	2020
Global Pharma Award Highly Commended Entry	Institution of Chemical Engineers	2019-20
Global Pharma Award Finalist	Institution of Chemical Engineers	2018-20
Elected Member	NCSU Global Engagement Academy	2019
Elected Member	NCSU Research Leadership Academy	2019
Visiting Professorship	University of Warsaw	2018
Outstanding Global Engagement Award	NC State University	2018
Alexander von Humboldt Research Fellowship	Humboldt University zu Berlin	2018
Visiting Professorship	Adam Mickiewicz University	2017-19
Outstanding Alumnus Award	Penn State Univ. Schuylkill Campus	2017
1st place (microscopy) and 2nd place (illustration)	NC State Research Image Contest	2017
Visiting Professorship	Humboldt University zu Berlin	2017
Erudite Professor	Mahatma Gandhi University	2017
Elected Fellow	NANOSMAT Society	2017
Goodnight Fellow	NC State Goodnight Scholars Program	2016
Alexander von Humboldt Research Fellowship	Technical University of Munich	2016
Alumni Distinguished Graduate Professor Award	NC State Alumni Association	2015
Invited Co-editor	*Thermoplastic Elastomers*, 4th Ed.	2015
Invited Short Course Instructor	Tsinghua University	2014
Innovator of the Year Award Finalist	Institution of Chemical Engineers	2012,13
Rubber Foundation Lecture	The Polymer Society (U.K.)	2012
External Advisory Board	Penn State Schuylkill Campus	2012-
Elected Honorary Fellow	Australian Inst. of High Energ. Mater.	2010
Innovative Product of the Year Award Finalist	Institution of Chemical Engineers	2010
Outstanding Mid-Career Teaching Award	ASEE[2] (Southeast Region)	2009
Tech Brief Award	National Aeronautics & Space Admin.	2008
Tewkesbury Fellowship	University of Melbourne (Australia)	2007
Outstanding Scholar Alumnus Award	Penn State Univ. Schreyer College	2007
Invited Delegate, *Prospects for European Integration*	Federal Republic of Germany	2006
Guest Co-Editor	*Materials Research Society Bulletin*	2006
Recognition Award	Int. Network for Eng. Ed. and Res.	2006
Alexander von Humboldt Research Fellowship	Technical University of Berlin	2004
George H. Blessis Outstanding Advisor Award	NC State College of Engineering	2003
1st Place, Energy Challenge National Competition	U.S. Department of Energy	2003
Science Advisory Board	SINTEF Materials Technology	2004-14
Multidisciplinary Senior Design Team Advisor Award	NC State Materials Science & Eng.	2002,01
Alumni Distinguished Undergraduate Professor Award	NC State Alumni Association	2001-
Outstanding Teaching Award	NC State Alumni Association	2000
Outstanding Teaching Award; induction into AOT[3]	NC State College of Engineering	2000
Alexander von Humboldt Research Fellowship	University of Freiburg	2000,98
Visiting Professorship	University of the Philippines	1999
Senior Design Team Advisor Award	NC State Materials Science & Eng.	1996,94
Outstanding Research Achievement Award	*Sigma Xi* Research Society	1995
Sigma Xi Research Honor Society	NC State University	1995
Alpha Sigma Mu Materials Science Honor Society	NC State Materials Science & Eng.	1995
Young Investigator Award	Becton Dickinson Research Center	1994
Visiting Scientist Fellowship	National Ctr for Electron Microscopy	1994

[2] American Society for Engineering Education

[3] Academy of Outstanding Teachers

Traveling Exhibit Poster Award	Microscopy Society of America	1994

Procter & Gamble Company

Team Achievement Award	Corporate Research Division	1992
Traveling Exhibit Poster Award	Microscopy Society of America	1992

Institute for Energy Technology

Research Fellowship	Royal Norwegian Council	1989

University of Cambridge

Advanced Study Institute Scholarship	North Atlantic Treaty Organization	1989
Edward Emley Award	Institute of Metals	1989
Visiting Associateship (extended life membership)	Clare Hall	1988
Research Fellowship	Hoechst-Celanese Corporation	1988-89

University of California at Berkeley

Sherwin-Williams Award Finalist	American Chemical Society (PMSE)	1987
Distinguished Scholar Award	Microbeam Analysis Society	1987
Research Achievement Award	WREMMA[4]	1987
Acting Instructorship (taught classes; oversaw TAs)	Department of Chemical Engineering	1987
Presidential Award	Electron Microscopy Soc. of America	1986
Outstanding Teaching Assistant Award	University of California at Berkeley	1985

Pennsylvania State University

University Scholars Medal (inaugural year)	Schreyer Honors College	1983
Phi Kappa Phi Honor Society	Pennsylvania State University	1982
Golden Key Honor Society	Pennsylvania State University	1982
Phi Lambda Upsilon Chemistry Honorary Society	Pennsylvania State University	1982
Omicron Delta Kappa Leadership Honor Society	Pennsylvania State University	1982
Tau Beta Pi Engineering Honorary Society	Pennsylvania State University	1981
ROTC[5] Superior Cadet Decoration	U.S. Army TRADOC[6]	1981
Director's Saber Award for Outstanding ROTC Cadet	Penn State Univ. Schuylkill Campus	1981
Scabbard & Blade Military Honor Society	Penn State Univ. Schuylkill Campus	1981
President's Freshman Scholar Award	Penn State Univ. Schuylkill Campus	1980

Research Highlights

Research results featured on journal cover	*J. Colloid Interface Science*	2020
Research results featured on website	*NPG Asia Materials*	2019
Research results featured on journal cover	*ACS Macro Letters*	2018
Research results featured on journal cover	*Journal of Chemical Physics*	2018
Research results featured on journal cover	*Solar Rapid Research Letters*	2018
Research results featured on journal cover	*Macromolecular Rapid Commun.*	2017
Research results featured on journal cover	*Soft Matter* (RSC)	2017
Research results featured on journal cover	*Proc. Royal Microscopy Society* (RMS)	2017
Research results featured on journal cover	*J. Polymer Science B: Polymer Physics*	2017
Research results featured on journal cover	*J. Polymer Science B: Polymer Physics*	2017
Research results featured on journal cover	*Macromolecular Rapid Commun.*	2016

[4] Western Regional Electron Microscopists & Microbeam Analysts

[5] Reserve Officers Training Corps

[6] Training and Doctrine Command

Research results featured on journal cover	*Macromolecular Rapid Commun.*	2015
Research results featured on journal cover	*Macromolecular Rapid Commun.*	2012
Research results featured on journal cover	*Langmuir* (ACS)	2011
Research results featured on journal cover	*J. Polymer Science B: Polymer Physics*	2011
Research results featured on journal cover	*Macromolecules* (ACS)	2010
Research results featured on journal cover	*Polymer*	2009
Research results featured on journal cover	*Advanced Materials*	2007
Research results featured on journal cover	*Materials Research Society Bulletin*	2006
Research results featured on journal cover	*Macromolecular Rapid Commun.*	2006
Research results featured on book *Developments in Block Copolymer Science & Technology*		2004
Research results featured on journal cover	*Langmuir* (ACS)	2004
Research results featured on journal cover	*Macromolecular Chemistry & Physics*	2004
Research results featured on journal cover	*Macromolecular Chemistry & Physics*	2003
Research results featured on journal cover	*Advanced Materials*	2003
Research results featured on journal cover	*Macromolecular Rapid Commun.*	2002
Research results featured on annual journal cover	*Macromolecular Materials & Eng.*	2000
Research results featured on journal cover	*Microscopy Today*	1999
Research results featured on journal cover	*Langmuir* (ACS)	1997
Research results featured on journal cover	*Journal of Materials Science*	1996
Research results featured on journal cover	*Langmuir* (ACS)	1996
Research results featured on journal cover	*Langmuir* (ACS)	1995
Research results featured on journal cover	*Microscopy Research & Technique*	1994

Work featured on NC State homepage/merchandise	NC State University	2019

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
Executive Committee Member (2018-) — North Carolina Section

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

American Energy Society 2015-17

American Physical Society 1991-06

Asian Council of Science Editors 2014-

Institute of Materials, Minerals and Mining 2011-

Materials Research Society 1990-14
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-)

The Minerals, Metals and Materials Society 2013-

American Association for the Advancement of Science 2017-

Synergistic Activities

Co-Editor	*Thermoplastic Elastomers, 4th Ed.*	2021-
Inaugural Editorial Advisory Board (UNC System)	*J. Digital Learning Innovations*	2021-

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	*NanoWorld Journal*	2020-
Editor-in-chief	*J. Encapsulation & Adsorption Sci.*	2014-
Associate Editor	*Open Chemistry Journal*	2014-21
Editorial Advisory Board	*American Chemical Science Journal*	2014-
Editorial Advisory Board	*Journal Chemical & Process Eng.*	2014-
Editorial Advisory Board	*NanoSciTech Open Library*	2014-
Editorial Advisory Board	*The Open Journal of Biochemistry*	2014-
Editorial Advisory Board	*Journal Nanotechnol. & Mater. Sci.*	2014-
Editorial Advisory Board	*German Journal of Materials Science*	2013-
Editorial Advisory Board	*American J. of Chemical Engineering*	2013-
Editorial Advisory Board	*Nanosci. & Technology: Open Access*	2013-
Editorial Advisory Board	*Chemical Eng. & Process Techniques*	2013-
Editorial Advisory Board	*SOJ Materials Science & Engineering*	2013-
Annual Editor-in-chief	*Innovations in Mater. Sci. & Eng.*	2013-14
Editorial Advisory Board	*Materials Science & Engineering Prog.*	2013-
Editorial Advisory Board	*Nanomaterials and Nanoscience*	2013-
Editor-in-chief	*Journal of Advanced Mechanical Eng.*	2011-12
Co-editor-in-chief	*Open J. Organic Polymer Materials*	2011-
Editor-in-chief	*Soft Nanoscience Letters*	2010-14
Editorial Advisory Board	*Langmuir* (ACS)	2008-10
Editor-in-chief	*Open Colloid Science Journal*	2008-12
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	*Tau Beta Pi* RTI Professional Chapter	2021-23
Founding Member, Ctr. for Adv. Virus Experimentation	NC State University	2020-
Elected Member, Faculty Assembly	University of North Carolina System	2020-23
Member, Faculty Hearing Committee	NC State University	2019-23
Faculty Co-advisor	*Tau Beta Pi* Honor Soc. Student Chap.	2019-
Invited Summer School Instructor	Peking University	2018
Goodnight Scholars Advisory Committee	NC State Goodnight Scholars Program	2015-
Scientific Advisory Group	Int. Symp. Polym. Anal., Houston, TX	2015
Faculty Co-advisor	SPE Student Chapter	2013-
Faculty Senate	NC State University	2012-16
Intellectual Property Committee	NC State University	2011-
Chair, Peer Evaluation of Teaching Committee	Department of Chemical Engineering	2008-
Invited Summer School Instructor	ICMR,[7] Univ. of CA at Santa Barbara	2007
Chair, Academic Misconduct Inquiry Board	NC State University	2006-08
Faculty Co-advisor (inaugural)	MRS Student Chapter	1998-00
Director of Graduate Admissions	Department of Chemical Engineering	1999-03
Faculty Advisor	NC State Squash Club	1996-00

[7] International Center for Materials Research

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.
- Mentored over 120 undergraduates and 54 graduate students in my research laboratory.
- Included 40 undergraduates as co-authors on peer-reviewed journal publications.
- 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 and Selection Committee.
- 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 undergraduate students from China, Turkey and Saudi Arabia, and graduate students from Canada, Norway, Germany, Japan, Thailand, and Australia.

Professional Recognition

- Received the College and NC State Alumni Association Outstanding Teaching Awards (inducted into the Academy of Outstanding Teachers), the George H. Blessis Advising Award, the NC State Alumni Association Undergraduate and Graduate Distinguished Professorships, and the Board of Governors' Award for Teaching Excellence (the highest teaching award offered) at NC State.
- 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 published 2 peer-reviewed publications related to engineering education.
- 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 give short courses at Humboldt University, Peking University, Tsinghua University, Norwegian University of Science & Technology, University of Oslo, University of Warsaw and Adam Mickiewicz University, as well as for the American Chemical Society (Rubber Division).

Instructional Methods

- Developed a software package to help students understand multicomponent phase equilibria.
- Introduced literature critiques and mock patent litigations to deepen knowledge and improve skills.
- Promoted in-class demonstrations and videos to augment classroom learning (videos at the undergraduate level have evolved to include accounts of "thermodynamic heroes," *e.g.*, historical figures, as well as living faculty such as S. Glotzer at Michigan and P. Debenedetti at Princeton).
- Conducted off-campus tours (some of which yielded internships or employment) for students at polymer-related industrial facilities around the state, and incorporated current research in classes.
- Prepared lecture recordings to augment in-class lectures 6 years ***before*** the COVID-19 pandemic.
- Provided optional problem/review sessions and required 5' student talks on contemporary topics.

Selection of 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 it 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."

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

"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!!"

Overview of Research Achievements *(primary themes could overlap)*

Healthcare

- Discovered inherently broad-spectrum antimicrobial polymers that could kill > 99.9% of MRSA, *C. difficile*, and SARS-CoV-2, as well as other bacteria, viruses and mold, in 5 minutes 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.
- Created a unique class of strain-reversible piezoresistive polymer nanocomposites from conventional or thermoplastic elastomers and carbon nanofiber for wearable and textile sensors.

Environment

- Designed & produced integrated gas-separation membranes by nanofabricating novel layered materials with record-shattering CO_2/N_2 selectivity ($>10^3$) and CO_2 permeability ($>10^3$ Barrer).
- Developed sustainable nanocellulose gas-separation membranes that exhibit exceptionally high CO_2 selectivity due to molecular size exclusion in the presence of an ionic liquid and humidity.
- Used charged thermoplastic elastomers alone or in the presence of an ionic liquid to generate highly basic- (NH_3) or acidic- (CO_2) selective 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 biodegradable.

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.
- Established how high-efficiency dielectric elastomers could 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 impregnated with different dyes.
- 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.
- Produced long-life water-in-salt electrolyte Li-ion batteries that charge faster than their analogs.

Basic Science/Materials Engineering

- 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.
- Developed a variety of new block copolymer systems (including gels) with controllable structures and properties for an improved fundamental understanding of molecular self-assembly and use.
- 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.
- Established that highly ordered multiscale structures can be engineered from the ground-up via the crystallization- or coordination-directed self-assembly of functional polymeric molecules.
- Demonstrated the mechanism by which charged thermoplastic elastomers self-assemble and how their morphologies can be either solvent-templated or altered via solvent-vapor/water annealing.
- Introduced a variety of physical and synthetic approaches to control the phase behavior of block polymers that self-assemble into nanoscale soft structures for use in various technologies.
- Identified the principle of time-composition superpositioning in thermoplastic elastomers that permits rigorous extrapolation of mechanical properties over 10 orders of magnitude in time.
- Pioneered transmission electron microtomography (TEMT) as a highly valuable characterization tool for obtaining/quantifying 3-D images of complex nanostructures in soft materials science.

Publications

Under review

9. Yan, J., Michel, R., Jansson, A., Braunfeld, M.B., Keszthelyi, B., Zheng, S.Q., Weikl, T., Gradzielski, M., and Spontak, R.J., "3D CryoTEM Analysis of Nanoparticle/Vesicle Interactions," *Phys. Rev. Lett.*, to be submitted (tentative title).

8. Yan, J., Jin, S.-A., Lee, B., and Spontak, R.J., "On the Transition from Rubber-Toughening to Thermoplastic-Elastomeric Behavior in Triblock Copolymer Blends," *Macromolecules*, to be submitted (tentative title).

7. Jin, S.-A. and Spontak, R.J., "Engineering Structured Colloids from Bionanoparticles with Tannic Acid at Different pH Levels," *Langmuir*, to be submitted (tentative title).

6. Peddinti, B.S.T., Yan, J., Scholle, F., Ghiladi, R.A., and Spontak, R.J., "Next-Generation Self-Disinfecting Anionic Block Polymers as Fast-Acting and Broad-Spectrum Antimicrobial Surfaces for Infection Control," *Mater. Horiz.* (invited), to be submitted (tentative title).

5. Sandru, M., Sandru, E., Stenstad, P.M., Ingram, W.F., Deng, J., Deng, L., and Spontak, R.J., "An Integrated Materials Approach to Ultrapermeable and Ultraselective CO_2 Membranes: Breaking the Upper Bound," *Science*, submitted.

4. 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*, submitted.

3. 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," *ACS Macro Lett.*, submitted.

2. 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), submitted.

1. Ciftci, Y., Peddinti, B.S.T., Ghiladi, R.A., Spontak, R.J., and Govind, R., "Preventing the Spread of *Clostridioides difficile* with a Continuously Self-Disinfecting Polymer," *Sci. Rep.*, submitted.

In press

5. Spontak, R.J., "A Unique Charged Block Polymer for Propitious Use in the Energy, Environment and Healthcare Sectors," in *Applications and Industrialisation of Nanotechnology* (W. Ahmed, ed.), One Central, in press.

4. Yan, J. and Spontak, R.J., "Advances in Stimuli-Responsive and Functional Thermoplastic Elastomers," in *Elastomer Blends and Composites: Principles, Characterizations, Advances and Applications* (M.R. Sanjay, J. Parameswaranpillai, S. Siengchin, and T. Ozbakkaloglu, eds.), Elsevier, in press.

3. Peddinti, B.S.T., Ghiladi, R.A., and Spontak, R.J., "Next-Generation Stimuli-Responsive Antimicrobial Coatings with Broad-Spectrum Efficacy," in *Handbook of Smart Polymer Coatings and Films* (P. Zarras, M. Soucek and Y. Wei, eds.), Wiley, in press.

2. Spontak, R.J., Peddinti, B.S.T., Roskov, K.E., and Sun, X., "Advances in Functionalizing the Interior and Exterior of Polymer Nanofibers," in *Science and Technology of Polymer Nanofibers*, *2nd Ed*. (A.L. Andrady and S.A. Khan, eds.), Wiley-Interscience, in press.

1. Abetz, V., Jinnai, H., Spontak, R.J., and Talmon, Y., "Determination of Bulk and Solution Morphologies by Electron Microscopy," in *Macromolecular Engineering: Precise Synthesis, Materials Properties, Applications, 2nd Ed*. (Y. Gnanou, N. Hadjichristidis, K. Matyjaszewski, M. Muthukumar, and S. Sheiko, eds.), Wiley-VCH, in press.

Peer-reviewed journal articles

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Publication Metrics (12 June 2021)

Google Scholar:	
Citations	14,083
h-index	62
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Average citations/publication	25.84

Patents

Pending

6. Peddinti, B.S.T., Scholle, F., Spontak, R.J., and Ghiladi, R.A., "Inherently Self-Disinfecting Coating Surfaces and Method for Making Thereof," U.S. patent filed May 2021. [exclusively licensed to Kraton Corp.]

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6. Shankar, R., Ghosh, T.K., and Spontak, R.J., "Electroactive Nanostructured Polymers as Tunable Organic Actuators," U.S. Patent #7,956,520, June 7, 2011.

5. DeSimone, J.M., Siripurapu, S., Khan, S.A., Spontak, R.J., and Royer, J.R., "Nano- and Micro-cellular Foamed Thin-Walled Materials, and Processes and Apparatuses for Making

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Invited Research Presentations (past 5 years)

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 CO2 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. "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.

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

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

284. "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].

283. "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]

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

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

280. "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.

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

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

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

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

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

274. "Charged Thermoplastic Elastomer Gels: Technological Opportunities and Self-Assembly Behavior," Department of Chemistry, University of South Carolina, Columbia, SC, 2017.

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

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

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

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

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

268. "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.

267. "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.

266. "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.

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

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

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

262. "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.

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

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

259. "Controlling Morphological and Property Development in Network-Forming Multiblock Ionomers," School for Engineering of Matter, Transport & Energy, Arizona State University, Tempe, AZ, 2016.

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

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

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

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

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

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

252. "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.

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

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

249. "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.

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