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Engineering & Scientific Consulting

Jacob Thelen, Ph.D.

Senior Associate | Polymers & Chemistry
Seattle
+1-206-676-6912 | jthelen@exponent.com

Professional Profile

Trained as a chemical engineer, Dr. Thelen assesses the characterization and performance of soft matter systems, such as bulk polymers, polymer membranes, organic thin films, and nanoparticle solutions. He routinely employs his expertise in X-ray, neutron, and light scattering/reflectivity methods to determine the structure-property-processing relationships for these systems in applications including batteries, 3D printing, gas separations, organic electronics, and mRNA vaccine delivery.

Dr. Thelen is also well-versed in microscopy (optical, SEM); thermal analysis (DSC, TGA); spectroscopic methods (FTIR, UV-Vis, VASE, NEXAFS, EDS); and electrochemical characterization (PEIS, CV, Battery Cycling).

Prior to joining Exponent, Dr. Thelen worked at GSK where he studied the nanostructure of lipid nanoparticle (LNP) mRNA delivery vehicles in order to guide formulation development of mRNA vaccines. He was also an NRC Postdoctoral Fellow at NIST where he developed a novel characterization method – polarized Resonant Soft X-ray Reflectivity (p-RSoXR) – which allowed for depth-profiling of molecular orientation in organic thin films with nanometer-level depth resolution.

Academic Credentials & Professional Honors

Ph.D., Chemical Engineering, University of California, Berkeley, 2016

B.S., Chemical Engineering, North Carolina State University, 2010

B.S., Chemistry, North Carolina State University, 2010

Prior Experience

Scientist, GSK Vaccines, 2020-2022

NRC Postdoctoral Fellow, NIST, 2017-2020

Patents

US9755273B2: Ion conducting fluoropolymer carbonates for alkali metal ion batteries, September 2017 (with J. M. DeSimone, A. Pandya, D. Wong, N. P. Balsara, D. Devaux)

US8587493B2: Reversibly deformable and mechanically tunable fluidic antennas, November 2013 (with M.D. Dickey, G. Lazzi, J-H. So, A. Qusba, G. J. Hayes)

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Publications

Wang, Meixiang; Zhang, Pengyao; Shamsi, Mohammad; Thelen, Jacob L; Qian, Wen; Truong, Vi Khanh; Ma, Jinwoo; Hu, Jian; Dickey, Michael D; Tough and stretchable ionogels by in situ phase separation, Nature Materials, 2022, 21(3), 359-365.

Ferron, Thomas J*; Thelen, Jacob L*; Bagchi, Kushal; Deng, Chuting; Gann, Eliot; de Pablo, Juan J; Ediger, MD; Sunday, Daniel F; DeLongchamp, Dean M; Characterization of the Interfacial Orientation and Molecular Conformation in a Glass-Forming Organic Semiconductor, ACS Applied Materials & Interfaces, 2022, 14(2), 3455-3466.
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Sunday, Daniel F; Thelen, Jacob L; Zhou, Chun; Ren, Jiaxing; Nealey, Paul F; Kline, R Joseph; Buried Structure in Block Copolymer Films Revealed by Soft X-ray Reflectivity, ACS nano, 2021, 15(6), 9577-9587.

Thelen, Jacob L; Bishop, Camille; Bagchi, Kushal; Sunday, Daniel F; Gann, Eliot; Mukherjee, Subhrangsu; Richter, Lee J; Kline, R Joseph; Ediger, MD; DeLongchamp, Dean M; Molecular orientation depth profiles in organic glasses using polarized resonant soft X-ray reflectivity, Chemistry of Materials, 2020, 32(15), 6295-6309.

Bishop, Camille; Thelen, Jacob L; Gann, Eliot; Toney, Michael F; Yu, Lian; DeLongchamp, Dean M; Ediger, Mark D; Vapor deposition of a nonmesogen prepares highly structured organic glasses, Proc. Nat. Acad. Sci., 2019, 116(43), 21421-21426.

Grundy, Lorena S; Sethi, Gurmukh K; Galluzzo, Michael D; Loo, Whitney S; Maslyn, Jacqueline A; Teran, Alexander A; Thelen, Jacob L; Timachova, Ksenia; Reimer, Jeffrey A; Madsen, Louis A; Detection of the Order-to-Disorder Transition in Block Copolymer Electrolytes Using Quadrupolar 7Li NMR Splitting, ACS Macro Letters, 2019, 8(2), 107-112.

Abbott, Lauren J; Buss, Hilda G; Thelen, Jacob L; McCloskey, Bryan D; Lawson, John W; Polyanion electrolytes with well-ordered ionic layers in simulations and experiment, Macromolecules, 2019, 52(15), 5518-5528.

Thelen, Jacob L; Wang, Andrew A; Chen, X Chelsea; Jiang, Xi; Schaible, Eric; Balsara, Nitash P; Correlations between salt-induced crystallization, morphology, segmental dynamics, and conductivity in amorphous block copolymer electrolytes, Macromolecules, 2018, 51(5), 1733-1740.

Devaux, Didier; Villaluenga, Irune; Bhatt, Mahesh; Shah, Deep; Chen, X Chelsea; Thelen, Jacob L; DeSimone, Joseph M; Balsara, Nitash P; Crosslinked perfluoropolyether solid electrolytes for lithium ion transport, Solid State Ionics, 2017, 310, 71-80.

Oh, Hee Jeung; Park, Jaesung; Inceoglu, Sebnem; Villaluenga, Irune; Thelen, Jacob L; Jiang, Xi; McGrath, James E; Paul, Donald R; Formation of disulfonated poly (arylene ether sulfone) thin film desalination membranes plasticized with poly (ethylene glycol) by solvent-free melt extrusion, Polymer, 2017, 109, 106-114.

Chintapalli, Mahati; Timachova, Ksenia; Olson, Kevin R; Banaszak, Michał; Thelen, Jacob L; Mecham, Sue J; DeSimone, Joseph M; Balsara, Nitash P; Incipient microphase separation in short chain perfluoropolyether-block-poly (ethylene oxide) copolymers, Soft Matter, 2017, 13(22), 4047-4056.

Thelen, Jacob L; Chen, X Chelsea; Inceoglu, Sebnem; Balsara, Nitash P; Influence of Miscibility on Poly (ethylene oxide) Crystallization from Disordered Melts of Block Copolymers with Lithium and Magnesium Counterions, Macromolecules, 2017, 50(12), 4827-4839.

Chintapalli, Mahati; Le, Thao NP; Venkatesan, Naveen R; Mackay, Nikolaus G; Rojas, Adriana A; Thelen,

Jacob L; Chen, X Chelsea; Devaux, Didier; Balsara, Nitash P; Structure and ionic conductivity of polystyrene-block-poly (ethylene oxide) electrolytes in the high salt concentration limit, Macromolecules, 2016, 49(5), 1770-1780.

Devaux, Didier; Wang, Xiaoya; Thelen, Jacob L; Parkinson, Dilworth Y; Cabana, Jordi; Wang, Feng; Balsara, Nitash P; Lithium metal-copper vanadium oxide battery with a block copolymer electrolyte, J. Electrochem Soc., 2016, 163(1), A2447.

Bhatt, Mahesh P; Thelen, Jacob L; Balsara, Nitash P; Effect of copolymer composition on electronic conductivity of electrochemically oxidized poly (3-hexylthiophene)-b-poly (ethylene oxide) block copolymers, Chemistry of Materials, 2015, 27(14), 5141-5148.

Rojas, Adriana A; Inceoglu, Sebnem; Mackay, Nikolaus G; Thelen, Jacob L; Devaux, Didier; Stone, Gregory M; Balsara, Nitash P; Effect of lithium-ion concentration on morphology and ion transport in single-ion-conducting block copolymer electrolytes, Macromolecules, 2015, 48(18), 6589-6595.

Su, Liang; Darling, Robert M; Gallagher, Kevin G; Xie, Wei; Thelen, Jacob L; Badel, Andres F; Barton, John L; Cheng, Kevin J; Balsara, Nitash P; Moore, Jeffrey S; An investigation of the ionic conductivity and species crossover of lithiated nafion 117 in nonaqueous electrolytes, J. Electrochem Soc., 2015, 163(1), A5253.

Thelen, Jacob L; Wu, Shao-Ling; Javier, Anna E; Srinivasan, Venkat; Balsara, Nitash P; Patel, Shrayesh N; Relationship between mobility and lattice strain in electrochemically doped poly (3-hexylthiophene), ACS Macro Letters, 2015, 4(12), 1386-1391.

Wong, Dominica HC; Vitale, Alessandra; Devaux, Didier; Taylor, Austria; Pandya, Ashish A; Hallinan, Daniel T; Thelen, Jacob L; Mecham, Sue J; Lux, Simon F; Lapides, Alexander M; Phase behavior and electrochemical characterization of blends of perfluoropolyether, poly (ethylene glycol), and a lithium salt, Chemistry of Materials, 2015, 27(2), 597-603.

Wang, Xin; Thelen, Jacob L; Teran, Alexander A; Chintapalli, Mahati; Nakamura, Issei; Wang, Zhen-Gang; Newstein, Maurice C; Balsara, Nitash P; Garetz, Bruce A; Evolution of grain structure during disorder-to-order transitions in a block copolymer/salt mixture studied by depolarized light scattering, Macromolecules, 2014, 47(16), 5784-5792

Chintapalli, Mahati; Chen, X Chelsea; Thelen, Jacob L; Teran, Alexander A; Wang, Xin; Garetz, Bruce A; Balsara, Nitash P; Effect of grain size on the ionic conductivity of a block copolymer electrolyte, Macromolecules, 2014, 47(15), 5424-5431.

Thelen, Jacob L; Teran, Alexander A; Wang, Xin; Garetz, Bruce A; Nakamura, Issei; Wang, Zhen-Gang; Balsara, Nitash P; Phase behavior of a block copolymer/salt mixture through the order-to-disorder transition, Macromolecules, 2014, 47(8), 2666-2673.

Wong, Dominica HC*; Thelen, Jacob L*; Fu, Yanbao; Devaux, Didier; Pandya, Ashish A; Battaglia, Vincent S; Balsara, Nitash P; DeSimone, Joseph M; Nonflammable perfluoropolyether-based electrolytes for lithium batteries, Proc. Nat. Acad. Sci., 2014, 111(9), 3327-3331.
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Thelen, Jacob; Dickey, Michael D; Ward, Thomas; A study of the production and reversible stability of EGaIn liquid metal microspheres using flow focusing, Lab on a Chip, 2012, 12(20), 3961-3967.

So, Ju□Hee; Thelen, Jacob; Qusba, Amit; Hayes, Gerard J; Lazzi, Gianluca; Dickey, Michael D; Reversibly deformable and mechanically tunable fluidic antennas, Advanced Functional Materials, 2009, 19(22), 3632-3637.

Presentations

Thelen, Jacob; Bishop, Camille; Sunday, Daniel; Gann, Eliot; Ediger, Mark; Delongchamp, Dean; Probing Molecular Orientation using Polarized Resonant Soft X-ray Reflectivity, APS March Meeting, 2019, Oral Presentation

Thelen, Jacob; Bagchi, Kushal; Bishop, Camille; Panidi, Julianna; Sunday, Daniel; Gann, Eliot; Engmann, Sebastian; Richter, Lee; Ediger, Mark; Delongchamp, Dean; Probing Molecular Orientation using Polarized Resonant Soft X-ray Reflectivity, Gordon Research Conference - Polymer Physics, 2018, Poster Presentation.

Thelen, Jacob; Sunday, Daniel; Engmann, Sebastian; Richter, Lee; DeLongchamp, Dean; Using Resonant Soft X-ray Reflectivity (RSoXR) to Probe Vertical Segregation in Organic Semiconducting Thin Films, Aps March Meeting, 2018, Oral Presentation.

Thelen, Jacob; Inceoglu, Sebnem; Venkatesan, Naveen R; Mackay, Nikolaus G;Balsara, Nitash P; Experimental Study of the Relationship between Ion Dissociation, Melt Morphology, and Electrochemical Performance of Ion-Containing Block Copolymers, Gordon Research Conference - Polymer Physics, 2016, Poster Presentation.

Thelen, Jacob; Inceoglu, Sebnem; Balsara, Nitash; Phase Behavior and Electrochemical Performance of Solid-State Magnesium Ion Electrolytes from Diblock Copolymers, APS March Meeting, 2015, Poster Presentation.

Thelen, Jacob L; Patel, Shrayesh N; Javier, Anna E; Balsara, Nitash P; Probing Structural Changes in Poly (3-hexylthiophene)(P3HT) During Electrochemical Oxidation with In Situ X-ray Scattering, APS March Meeting, 2014, Oral Presentation.

Thelen, Jacob; Balsara, Nitash; Investigation of phase coexistence in block copolymer/salt mixtures near order-disorder phase transitions, APS March Meeting, 2013, Poster Presentation.

Peer Reviews

Macromolecules