Exponent®
Engineering & Scientific Consulting

Ryan Fox, Ph.D.

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Professional Profile

Dr. Fox is a materials scientist and chemical engineer specializing in the analysis of the physical and chemical properties of polymer materials and complex fluids, including engineering thermoplastics, crosslinked thermosets, high-performance polymers, liquid crystal polymers, hydrogels, organogels, emulsions, polymer nanocomposites, carbon nanomaterials (i.e., graphene, carbon nanotubes, carbon black), surfactants, polyelectrolytes, polymer electrolyte membranes, solid-state battery membranes, shear thickening fluids, colloidal suspensions, self-assembled nanostructures, nanoparticle dispersions, bioadhesive membranes, foams, and antifoams.

Dr. Fox assists clients in understanding the structure-function-property relationships and failure modes of such materials in a wide variety of industries and applications, such as oil, gas, and water pipelines, high voltage (HV) cables and electrical wiring, construction materials (adhesives, sealants, coatings, membranes), medical devices, sporting equipment, automotive components, and consumer electronic devices, among others.

Dr. Fox routinely investigates failures of piping systems manufactured from polyethylene (e.g., MDPE, HDPE), polyvinyl chloride (PVC, CPVC), and many other polymeric materials. He is a certified pipe fusion inspector and large diameter pipe butt fusion operator with a deep working knowledge of material property testing and industry standards for pipe joining methods. Moreover, he is able to employ his extensive experience applying physical and chemical analytical techniques to solve materials-related questions and to perform root-cause investigations, including oscillatory and steady-shear rheology, dynamic mechanical thermal analysis (DMTA), tensile testing, thermogravimetric analysis (TGA), differential scanning calorimetry (DSC), capillary viscometry, small- and wide-angle x-ray scattering (SAXS/WAXS), small-angle neutron scattering (SANS), dynamic and static light scattering (DLS/SLS), Fourier-transform infrared (FTIR) spectroscopy, UV/Vis spectrophotometry, scanning electron microscopy (SEM), polarized optical microscopy (POM), and atomic force microscopy (AFM).

Prior to joining Exponent, Dr. Fox was a graduate research assistant at the University of North Carolina at Chapel Hill in the Department of Applied Physical Sciences. His research focused on the structure, rheology, and nanocomposites of liquid crystal polymers. As part of his doctoral research, Dr. Fox was funded by the Department of Energy as a visiting researcher at Oak Ridge National Laboratory employing rheo-SANS to investigate the structure and alignment of liquid crystal polymers under shear.

Academic Credentials & Professional Honors

Ph.D., Materials Science, University of North Carolina, Chapel Hill, 2020

B.S., Chemical Engineering, North Carolina State University, 2016

Department of Energy Office of Science Graduate Student Research (DOE SCGSR) Fellowship, 2019

Prior Experience

Graduate Research Assistant, University of North Carolina at Chapel Hill, 2016—2020

DOE Office of Science Graduate Student Research (SCGSR) Fellow, Oak Ridge National Laboratory, 2019—2020

Undergraduate Research Assistant, North Carolina State University, 2014—2016

Fermentation Optimization Intern, Novozymes, Summer 2015

Formulation and Process Engineering Co-op, Stiefel, a GlaxoSmithKline company, Spring and Fall 2014

Professional Affiliations

American Chemical Society (ACS)

Society of Rheology (SOR)

Publications

Fox RJ, Hegde M, Cole DP, Moore RB, Picken SJ, Dingemans TJ. High-Strength Liquid Crystal Polymer-Graphene Oxide Nanocomposites from Water. ACS Appl. Mater. Interfaces 2022; 14(14):16592-16600. DOI: 10.1021/acsami.2c00186 (Featured as a Supplementary Cover).

Dahl DK, Whitesell AN, Sharma-Huynh P, Maturavongsadit P, Janusziewicz R, Fox RJ, Loznev HT, Button B, Schorzman AN, Zamboni W, Ban J, Montgomery SA, Carey ET, Benhabbour SR. A mucoadhesive biodissolvable thin film for localized and rapid delivery of lidocaine for the treatment of vestibulodynia. Int. J. Pharm. 2022; 612:121288. DOI: 10.1016/j.ijpharm.2021.121288.

Yu D, Zanelotti CJ, Fox RJ, Dingemans TJ, Madsen LA. Solvent-Cast Solid Electrolyte Membranes Based on a Charged Rigid-Rod Polymer and Ionic Liquids. ACS Appl. Energy Mater. 2021; 4(7):6599-6605. DOI: 10.1021/acsaem.0c03133.

Fox RJ, Chen WR, Do C, Picken SJ, Forest MG, Dingemans TJ. Fingerprinting the Nonlinear Rheology of a Liquid Crystalline Polyelectrolyte. Rheo. Acta 2020; 59:727-743. DOI: 10.1007/s00397-020-01234-4.

Fox RJ, Hegde M, Zanelotti CJ, Kumbhar AS, Samulski ET, Madsen LA, Picken SJ, Dingemans TJ. Irreversible Shear-Activated Gelation of a Liquid Crystalline Polyelectrolyte. ACS Macro Lett. 2020; 9:957-963. DOI: 10.1021/acsmacrolett.0c00168 (Featured as a Supplementary Cover).

Fox RJ, Forest MG, Picken SJ, Dingemans TJ. Observation of Transition Cascades in Sheared Liquid Crystalline Polymers. Soft Matter 2020; 16:3891-3901. DOI: 10.1039/D0SM00275E (Featured as an Inside Cover).

Hegde M, Yang L, Vita F, Fox RJ, van de Watering R, Norder B, Lafont U, Francescangeli O, Madsen LA, Picken SJ, Samulski ET, Dingemans TJ. Strong Graphene Oxide Nanocomposites from Aqueous Hybrid Liquid Crystals. Nat. Commun. 2020; 11(830):1-7. DOI: 10.1038/s41467-020-14618-0.

Fox RJ, Yu D, Hegde M, Kumbhar AS, Madsen LA, Dingemans TJ. Nanofibrillar Ionic Polymer Composites Enable High-Modulus Ion-Conducting Membranes. ACS Appl. Mater. Interfaces 2019; 11(43):40551-40563. DOI: 10.1021/acsami.9b10921 (Featured as a Supplementary Cover).

Chang D, Fox RJ, Hicks E, Ferguson R, Chang K, Osborne D, Hu W, Velev OD. Investigation of interfacial properties of pure and mixed poloxamers for surfactant-mediated shear protection of mammalian cells. Colloids Surf B Biointerfaces 2017; 156:358-365. DOI: 10.1016/j.colsurfb.2017.05.040.

Presentations

Fox RJ, Forest MG, Picken SJ, Dingemans TJ. Observation of Transition Cascades in Liquid Crystalline Rods under Shear. Poster presentation, Gordon Research Conference, Ventura, CA, 2020.

Fox RJ, Hegde M, Kumbhar AS, Samulski ET, Madsen LA, Picken SJ, Dingemans TJ. Shear-Induced Gelation of Charged Liquid Crystalline Rods. Oral presentation, Society of Rheology 91st Annual Meeting, Raleigh, NC, 2019.

Fox RJ, Hegde M, Kumbhar AS, Samulski ET, Madsen LA, Picken SJ, Dingemans TJ. Shear-Induced Gelation of Charged Liquid Crystalline Rods. Oral presentation, Southeast Polymer Forum, Oak Ridge, TN, 2019.

Fox RJ, Hegde M, Kumbhar AS, Samulski ET, Madsen LA, Picken SJ, Dingemans TJ. Shear-Induced Gelation of a Liquid Crystalline Polyelectrolyte. Poster presentation, Soft Matter Workshop, Durham, NC, 2019.

Fox RJ, Hegde M, Cole DP, Dingemans TJ. Nanocarbon Dimensionality Controls Molecular Aggregation of an All-Aromatic Polyetherimide. Poster presentation, ORNL User Group Meeting, Oak Ridge, TN, 2019.

Fox RJ, Yu D, Kumbhar AS, Samulski ET, Madsen LA, Dingemans TJ. Supramolecular Nanofibrillar Networks Enable High Modulus Polymer Electrolyte Membranes. Oral presentation, The Future of Materials III Workshop, Raleigh, NC, 2019. (2nd place speaker award)

Fox RJ, Hegde M, Dingemans TJ. Mechanical Reinforcement of Liquid Crystal Polymers with Liquid Crystal Graphene Oxide. Poster presentation, ACS Polycondensation, Alexandria, VA, 2018.

Fox RJ, Hegde M, Dingemans TJ. Mechanical Reinforcement of Liquid Crystal Polymers with Liquid Crystal Graphene Oxide. Poster presentation, Soft Matter Workshop, Raleigh, NC, 2018.

Fox RJ, Hegde M, Dingemans TJ. Mechanical Reinforcement of Liquid Crystal Polymers with Liquid Crystal Graphene Oxide. Oral presentation, 13th National Graduate Research Polymer Conference, Minneapolis, MN, 2018. (Outstanding speaker award)

Fox RJ, Hegde M, Dingemans TJ. High Performance Polymer-Graphene Oxide Nanocomposites from Aqueous Liquid Crystals. Oral presentation, The Future of Materials II Workshop, Raleigh, NC, 2018. (1st place speaker award)

Fox RJ, Hegde M, Dingemans TJ. High Performance Polymer-Graphene Oxide Nanocomposites from Aqueous Liquid Crystals. Oral presentation, Carolina Science Symposium, Raleigh, NC, 2017. (1st place speaker award)

Fox RJ, Hegde M, Dingemans TJ. Rods Meet Plates: Nanocomposites from Water Soluble Rigid-Rod Polymers and Graphene Oxide Platelets. Poster presentation, Southeast Polymer Forum, Virginia Tech, VA, 2017

Fox RJ, Hegde M, Dingemans TJ. Rods Meet Plates: Nanocomposites from Water Soluble Rigid-Rod Polymers and Graphene Oxide Platelets. Poster presentation, Soft Matter Workshop, Chapel Hill, NC, 2017.

Fox RJ, Mertens B, Velev OD. Novel Deactivation Strategies for Norovirus Using Colloidal and Molecular Systems. Poster presentation, ACC Meeting of the Minds, Syracuse, NY, 2016

Fox RJ, Mertens B, Velev OD. Novel Deactivation Strategies for Norovirus Using Copper-Infused Lignin

Nanoparticles. AIChE National Student Conference, Salt Lake City, UT, 2015. (1st place poster award)

Fox RJ, DeFreese EC, Gould ST. Improved Foam Control of Industrial Enzyme Fermentations. Poster presentation, 14th Annual NC State University Undergraduate Research Symposium, Raleigh, NC, 2015

Fox RJ, Whiteman JE, Baker MR. Characterizing Scale Up and Shear Geometry of Batch Rotor-Stator Mixers. Poster presentation, AIChE Southern Regional Conference, Clearwater, FL, 2015. (1st place poster award)

Additional Education & Training

Polyethylene Pipe Large Diameter Fusion Operator Qualification (Butt Fusion per ASTM F2620), McElroy University™, 2022

Polyethylene Pipe Fusion Inspector Qualification (Socket Fusion, Saddle Fusion, Butt Fusion, Data Logging, Joint Integrity Testing per ASTM F2620 and ASTM F3124), McElroy University™, 2022

20th National School on Neutron and X-Ray Scattering, Argonne National Laboratory and Oak Ridge National Laboratory, 2018.