Exponent®
Engineering & Scientific Consulting

Michael Kreder, Ph.D.

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Professional Profile

Dr. Kreder specializes in helping clients address challenges related to the design and end-use performance of polymeric components incorporating materials such as rigid plastics, elastomers, rubbers, adhesives, sealants, coatings, textiles, membranes, and foams for use in a variety of applications, including automotive vehicles, consumer products and electronics, medical devices, oil and gas, construction, and water distribution systems. He has extensive experience using his broad knowledge of materials science to conduct root cause investigations into failures of polymeric components, including cracking/fracture, adhesive failure, leaking, or excessive deformation and wear. His deep knowledge of the physical and chemical properties of polymers allows him to further support clients with material processing and manufacturing, yield improvement, recall support, identification and characterization of contaminants, material selection, and the technical aspects of product liability or patent litigation.

Dr. Kreder routinely uses analytical techniques to assess the chemical, thermal, and mechanical properties of engineered materials. He has experience implementing standards-based or application-specific testing procedures to evaluate the end-use performance of polymeric materials and products. He frequently assists clients by evaluating the role of environmental and end-use conditions in polymer failure and has conducted investigations into potential manufacturing and design defects. He specializes in using optical microscopy (OM) and scanning electron microscopy (SEM) to visualize and characterize surface topography and morphology for a variety of applications, including failure analysis, characterization of contaminants, and polymer fractography. For example, Dr. Kreder has conducted or supported dozens of investigations into fractured pipes, hoses, tubes, or fittings that led to water damage in residential or commercial settings. When necessary, these investigations may include microscopic analysis of components and/or chemical testing of polymeric materials and associated contaminants using techniques such as FTIR or GC-MS.

Dr. Kreder has particular expertise in the area of interfacial science and solid-liquid interactions, encompassing thin film application and analysis, filtration, capillarity, porous flows, surface fouling, surface charging, and characterization of surface properties using techniques such as contact angle analysis and tensiometry. He has extensive experience developing custom optical systems for interferometric analysis of the thickness and dynamics of liquid thin films. Dr. Kreder has employed and developed various scientific approaches to modify the surface energy and wetting properties of a wide range of materials with molecular monolayers and polymer brushes of various chemistries, with a particular focus on alkyl, perfluorinated and siloxane-based molecules.

Prior to joining Exponent, Dr. Kreder received his doctorate in Applied Physics from Harvard University, where he researched and developed novel lubricant-infused repellent coatings. In addition to interfacial properties, he extensively studied the thermodynamic and kinetic properties of materials and worked to describe the behavior of swellable polymers. His current research interests also include the fractographic behavior of polymeric materials.

Academic Credentials & Professional Honors

Ph.D., Applied Physics, Harvard University, 2019

S.M., Applied Physics, Harvard University, 2015

B.A.Sc., Nanotechnology Engineering, University of Waterloo, 2013

Academic Appointments

Worcester Polytechnic Institute Department of Mechanical & Materials Engineering, Adjunct Professor, 2025

Professional Affiliations

Society of Plastics Engineers

ASM International

Patents

US Patent Application 2021005248: Designs for tympanostomy conduits or subannular ventilation conduits and other medical and fluidic conduits, Filed March 2019 (Black NL, Pavlichenko I, Kreder MJ, Kozin ED, Remenschneider AK, Aizenberg J, Patel H)

Publications

H. Patel, I. Pavlichenko, A. Grinthal, C. T. Zhang, J. Alvarenga, M.J. Kreder, J.C. Weaver et al. "Design of medical tympanostomy conduits with selective fluid transport properties." Science Translational Medicine (2023) 15, no. 690.

Y. Yao, R.K. Bennett, Y. Xu, A.M. Rather, S.Li, T. C. Cheung, A. Bhanji, M.J. Kreder, D. Daniel, S. Adera, and J. Aizenberg, “Wettability-based ultrasensitive detection of amphiphiles through directed concentration at disordered regions in self-assembled monolayers.” Proceedings of the National Academy of Sciences (2022), 119(43), p.e2211042119.

S. Kolle, O. Ahanotu, A. Meeks, S. Stafslien, M.J. Kreder, L. Vanderwal, L. Cohen, G. Waltz, C.S. Lim, D. Slocum, and E.M. Greene, “On the mechanism of marine fouling-prevention performance of oil-containing silicone elastomers.” Scientific reports (2022), 12(1), pp.1-13.

M.J. Kreder, D. Daniel, A. Tetreault, Z. Cao, B. Lemaire, J.V.I. Timonen, and J. Aizenberg, “Film Dynamics and lubricant depletion by droplets moving on lubricated surfaces.” Physical Review X (2018) 8, 031053

D. Daniel, J.V.I Timonen, R. Li, S.J. Velling, M.J. Kreder, A. Tetreault, and J. Aizenberg, “Origins of Extreme Liquid Repellency on Structured, Flat, and Lubricated Hydrophobic Surfaces.” Physical Review L (2018) 120, 244503

M.J. Kreder, J. Alvarenga, P. Kim, and J. Aizenberg, “Design of anti-icing surfaces: smooth, textured or slippery?” Nature Reviews Materials (2016) 1, 15003

O. Lubovsky, M.J. Kreder, D. Wright, A. Kiss, A. Gallant, H. Kreder, and C. Whyne, “Quantitative measures of damage to subchondral bone are associated with functional outcome following treatment of displaced acetabular fractures.” Journal of Orthopaedic Research (2013) 31, 1980

R. Denomme, K. Iyer, M.J. Kreder, B. Smith, and P. Nieva, “Nanoparticle fabrication by geometrically confined nanosphere lithography.” J. Micro Nanolithogr. MEMS MOEMS (2013) 12, 031106

P. Kim, M.J. Kreder, J. Alvarenga, and J. Aizenberg, “Hierarchical or Not? Effect of the Length Scale and Hierarchy of the Surface Roughness on Omniphobicity of Lubricant-Infused Substrates.” Nano Letters (2013) 13, 1793

P. Wilson, W. Lu, H. Xu, P. Kim, M.J. Kreder, J. Alvarenga, and J. Aizenberg, "Inhibition of Ice Nucleation by Slippery Liquid-Infused Porous Surfaces (SLIPS)." Phys Chem Chem Phys (2013) 15, 58

P. Kim, T. S. Wong, J. Alvarenga, M.J. Kreder, W. Adorno-Martinez, and J. Aizenberg, "Liquid-Infused Nanostructured Surfaces with Extreme Anti-Ice and Anti-Frost Performance." ACS Nano (2012) 6, 6569

Presentations

V. Nirankari, M.J. Kreder, J. McGann. “Ultrasonic Welds: Understanding Failures in Metal and Plastic Joints.” International Materials Applications & Technologies Conference (IMAT), Detroit, MI, October 2025.

E. Fitzharris, M.J. Kreder, C. Lee (presented), J. Moll. “Effect of Stress, Material, and Exposure Route on ESC.” International Materials Applications & Technologies Conference (IMAT), Cleveland, OH, October 2024.

M.J. Kreder, E. Fitzharris, C. Lee, J. Moll. “Polymer Fractography and the Many Faces of Environmental Stress Cracking.” ASM International – Joint Meeting of Central Massachusetts and Boston Chapters, February 21, 2024.

N. Budiansky, B. Jing, R. Fox, M.J. Kreder, J. Moll, S. MacLean. “Extra Large Polymer Sample Microtomy: Ask a Woodworker.” International Materials Applications & Technologies Conference (IMAT), Detroit, October 2023.

E. Fitzharris, M.J. Kreder (presented), C. Lee, J. Moll. “ESC Fractography: A Study Varying Stress in Two Amorphous Polymers.” International Materials Applications & Technologies Conference (IMAT), New Orleans, September 2022.

M.J. Kreder, D. Daniel, A. Tetreault, Z. Cao, B. Lemaire, J.V.I. Timonen, and J. Aizenberg. "Film dynamics and lubricant depletion by droplets moving on lubricated surfaces." APS Division of Fluid Dynamics, Atlanta, GA, November 2018 (Oral Presentation)

M.J. Kreder, D. Daniel, and J. Aizenberg. "Condensation and Freezing on SLIPS." GRC: Micro & Nanoscale Phase Change Heat Transfer, Galveston, TX, January 2017 (Poster Presentation)