



Exponent[®]

Engineering & Scientific Consulting

Michael Kreder, Ph.D.

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Professional Profile

Dr. Kreder specializes in the characterization, properties and end-use performance of polymeric materials, including elastomers, rigid plastics, adhesives, coatings, paints, textiles, membranes and foams. He has particular expertise in the area of interfacial science and solid-liquid interactions, encompassing thin film application and analysis, characterization of surface properties, filtration, capillarity, porous flows and surface fouling.

Dr. Kreder has extensive experience using his broad knowledge of materials science to conduct failure investigations of polymeric components in a wide number of products, such as fluid handling systems, medical devices, automotive vehicles, construction or building materials, and consumer electronics. Dr. Kreder's deep knowledge of the physical and chemical properties of polymers allows him to further support clients with material processing and manufacturing, yield improvement, material selection, and end-use testing. He regularly assists clients with the technical aspects of product liability and patent litigation.

Dr. Kreder specializes in using optical microscopy, scanning electron microscopy (SEM) and atomic force microscopy (AFM) to visualize and characterize surface topography and morphology for a variety of applications, including failure analysis and polymer fractography. He has extensive experience developing custom optical systems for interferometric analysis of the thickness and dynamics of liquid thin films.

Dr. Kreder has expertise in measuring the interfacial properties of solids, liquids and surfactant mixtures using tensiometry and contact angle analysis, and he is experienced in thin film techniques such as spin-coating, doctor-blading, and dip-coating polymers and sol-gel solutions. 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. In addition, Dr. Kreder routinely uses analytical techniques such as UV-Vis, FTIR, Raman, XRD, TGA, and DSC to assess the composition of engineered materials.

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

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

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

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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

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)