

Exponent®
Engineering & Scientific Consulting

Abigail Oelker, Ph.D.

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Professional Profile

Dr. Oelker utilizes expertise in chemicals and materials characterization to provide clients in a variety of industries with product development and failure analysis solutions. Trained as a chemical engineer and chemist, she specializes in the design and evaluation of polymeric materials and small molecule additives.

Dr. Oelker has experience with materials selection, deformulation, and failure analysis of polymer films, emulsifiers and emulsion polymers, medical devices, high-performance textiles, dyes, carpets, coatings, reflective insulation, and injectable hydrogels. Dr. Oelker has expertise in the synthesis, characterization, and use of hydrogels in a variety of applications. While at Exponent, Dr. Oelker has assisted clients in failure analysis and characterization of hydrogels for consumer electronics, sensors, diapers, and medical applications, including various injectable hydrogel-based therapeutics and hydrogels for dermal application.

Dr. Oelker also has expertise in the evaluation of fabric and garment construction, fabric identification, and characterization of the mechanical, physical, and chemical properties of fabrics. While at Exponent, Dr. Oelker has supported clients on matters involving infrared absorbing composite materials, infrared reflecting composite materials, cushioned athletic wear, absorbent non-wovens, footwear cushions, and absorbent multicomponent materials for athletic wear. She has experience with the characterization of fabrics and garments using standardized testing including with methods published by the American Association of Textile Colorists and Chemists (AATCC), ASTM and ISO. She also has experience with the development of specialized, non-standard test methods for material characterization.

Dr. Oelker has hands-on experience with small molecule and polymer synthesis, modification, and purification as well as hydrogel design, cross-linking, and characterization. She is skilled in molecular characterization techniques such as nuclear magnetic resonance (NMR) spectroscopy, Fourier transform infrared (FTIR) spectroscopy, fluorometry, dynamic light scattering (DLS), ultraviolet-visible (UV-Vis) spectroscopy, circular dichroism (CD) spectroscopy, gel permeation chromatography (GPC), and gas chromatography techniques such as gas chromatography-mass spectrometry (GC-MS). In addition, she has an extensive background in materials characterization techniques including microscopy (optical, confocal), rheology, nanoindentation, differential scanning calorimetry (DSC), thermogravimetric analysis (TGA), and profilometry.

Prior to joining Exponent, Dr. Oelker was a postdoctoral associate in the department of chemical engineering at MIT where she developed polypeptide hydrogel substrates with independently tunable stiffness, permeability, and ligand presentation for the study of disease mechanisms and in vitro therapeutic testing. This research built upon her graduate work at Boston University, where she synthesized and characterized a variety of polymers for use as surgical adhesives and implants.

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Academic Credentials & Professional Honors

Ph.D., Chemistry, Boston University, 2009

B.S., Chemical Engineering, Lehigh University, 2003

Professional Affiliations

American Chemical Society

AATCC

Publications

Anderson DM, Oelker AM, Beckham HW. Thermal Analysis of Textiles in Analytical Methods for a Textile Laboratory, 4th Edition, American Association of Textile Chemists and Colorists, Research Triangle Park, N.C., USA 2023.

Oelker AM, Morey SM, Griffith LG, Hammond PT. Helix versus coil polypeptide macromers: gel networks with decoupled stiffness and permeability. Soft Matter 2012; 8:10887.

Oelker AM, Berlin JA, Wathier M, Grinstaff MW. Synthesis and characterization of dendron cross-linked PEG hydrogels as corneal adhesives. Biomacromolecules 2011; 12:1658.

Oelker AM, Grinstaff MW. Synthesis, characterization, and in vitro evaluation of a hydrogel-based corneal onlay. 2011; 11:37.

Oelker AM, Grinstaff MW. Ophthalmic adhesives: a materials chemistry perspective. Journal of Materials Chemistry 2008; 18:2521.

Spirko JA, Neiman ML, Oelker AM, Klier K. Electronic structure and reactivity of defect MoS2 II. Bonding and activation of hydrogen on surface defect sites and clusters. Surface Science 2004; 572:191.

Spirko JA, Neiman ML, Oelker AM, Klier K. Electronic structure and reactivity of defect MoS2: I. Relative stabilities of clusters and edges, and electronic surface states. Surface Science 2003; 542:192.

Presentations

Oelker A, Clayman N, Kratochvil M, Vargas, J. Failure Analysis of Hydrogels: Case Studies in the Biomedical Space, Society for Biomaterials, Atlanta, GA, 2026.

Oelker A, Park HB. Prior Art Searching in the Age of AI: Case Studies of Contemporary Technologies in the Chemical IP Space, American Chemical Society Spring Meeting, Atlanta, GA, 2026.

Oelker A, Kratochvil M, Vargas J. From Construction to Agriculture: Surprising Applications of Hydrogels, American Chemical Society Fall Meeting, Washington, DC, 2025.

Wilts E, Oelker A, Vargas J. In Situ Curing Polymeric Materials for Dermal Applications, Oral presentation, American Chemical Society Fall Meeting, Denver, CO, 2024.

Lyons C, Oelker AM. Sustainability Case Studies in Plastics Manufacturing, Oral presentation, American Chemical Society Fall Meeting, Chicago, IL, 2022.

Barry M, Oelker AM, Parker S. The Role of Technical Experts in Patent Litigation, Oral presentation, American Chemical Society Fall Meeting, Atlanta, GA, 2021.

Stern M, Oelker AM, Parker S, Kytomaa H, Krill M. Patentable or Infringing? An Overview of Patent Infringement and Validity Concepts for Researchers and Innovators. Oral presentation, AIChE Annual Meeting, virtual, 2020.

Oelker AM, Ledwith PA, Bauer DR, Beckham HW. Failure Analysis of Adhesives Used in Fibrous Substrates, Oral presentation, American Association of Textile Chemists and Colorists Annual Meeting, Wilmington, NC, 2017.

Oelker AM, Griffith LG, Hammond PT. "Click"-grafted polypeptide macromers: Components of a hydrogel toolkit for modeling cell-matrix interactions. Oral presentation, Materials Research Society Annual Meeting, San Francisco, CA, 2012.

Oelker AM, Griffith LG, Hammond PT. Synthetic polypeptide macromers with tunable secondary structure: components of a hydrogel toolkit for modeling cell-matrix interactions. Oral presentation, AIChE Annual Meeting, Minneapolis, MN, 2011.

Oelker AM, Griffith LG, Hammond PT. "Click"-grafted polypeptides: Structural macromers with tunable conformation. Poster presentation, American Chemical Society National Meeting, Boston, MA, 2011.

Oelker AM, Griffith LG, Hammond PT. Synthetic polypeptide macromers: Components of a hydrogel toolkit for modeling cell-matrix interactions. Oral presentation, Emergent Behaviors of Integrated Cellular Systems: Multi-Institutional Trainee Research Symposium, Cambridge, MA, 2011.

Oelker AM, Griffith LG, Hammond PT. "Click" grafted polypeptides: Structural macromers with tunable conformation. Poster presentation, American Chemical Society National Meeting, Anaheim, CA, 2011.

Oelker AM, Griffith LG, Hammond PT. Structural polypeptide macromers with tunable secondary structure as components of a modular synthetic ECM. Poster presentation, Materials Research Society National Meeting, Boston, MA, 2010.

Oelker AM, Wathier M, Grinstaff MW. Hybrid poly(2-hydroxyethyl methacrylate) and dendritic polymer hydrogels as scaffolds for corneal tissue engineering. Oral presentation, American Chemical Society National Meeting, Philadelphia, PA, 2008.

Oelker AM, Grinstaff MW. Epithelialization of collagen-modified poly(2-hydroxyethyl methacrylate) hydrogels for corneal implants. Poster presentation, Association for Research in Vision and Ophthalmology Annual Meeting, Fort Lauderdale, FL, 2008.

Oelker AM, Grinstaff MW. Characterization of collagen-modified poly(2-hydroxyethyl methacrylate) hydrogels for use as corneal implants. Poster presentation, American Chemical Society National Meeting, Boston, MA, 2007.

Oelker AM, Grinstaff MW. Characterization of poly(2-Hydroxyethyl Methacrylate) hydrogels for corneal grafts. Oral presentation, Society for Biomaterials National Meeting, Chicago, IL, 2007.

Oelker AM, Wathier M, Grinstaff MW. Evaluation of lysine dendrons for self-crosslinking hydrogels. Poster presentation, American Chemical Society National Meeting, Philadelphia, PA, 2004.

Additional Education & Training

Postdoctoral Associate, Department of Chemical Engineering, Massachusetts Institute of Technology (MIT)