

Exponent®
Engineering & Scientific Consulting

Rusul Mustafa, Ph.D.

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Professional Profile

Dr. Mustafa is a chemist specializing in optical spectroscopy, microscopy, and materials characterization. She has extensive experience designing custom optical setups, analyzing polymers, hydrogels, and nanocomposites. She has a background in developing vibrational spectroscopy techniques to investigate polymer and hydrogel interactions with genetic materials, advancing applications in gene and drug delivery. She also has expertise in developing analytical approaches for environmental and cosmetic studies.

Dr. Mustafa routinely performs characterization and structure–property relationship studies on polymeric material systems using standardized methods and instrumentation. She is highly skilled in techniques including FTIR and Raman spectroscopy, chromatography, TEM, SEM, confocal microscopy, AFM, multiphoton microscopy, and mass spectrometry. In addition, she has experience in characterizing the mechanical properties of polymers, including tensile testing. She also brings experience in cell culture and tissue characterization.

Prior to joining Exponent, Dr. Mustafa completed her PhD in Chemistry at the University of Vermont, where she led various projects, including developing Raman and FTIR spectroscopy methods to study polymeric nanoparticle formation and their role in genetic material release within cells, providing key insights on the molecular interactions that occur between polymers and their genetic cargos. These insights provide an essential foundation to design more efficient polymer delivery vectors. Earlier, she worked at Eurofins, preparing and analyzing metals and pesticides content in environmental samples.

Academic Credentials & Professional Honors

Ph.D., Analytical Chemistry, University of Vermont, 2025

B.S., Chemistry, Saint Michael's College, 2019

B.S., Chemistry, Al-Mustansyria University, 2016

Prior Experience

Graduate writing consultant, University of Vermont, 2023-2025

Graduate research assistant, University of Vermont, 2020-2025

Lab Technician, Eurofins, 2018-2020

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Professional Affiliations

2024, American Association for the Advancement of Science, member

2023, American Chemical Society, member

2023, Coblentz society, member

2023, Society for applied spectroscopy, member

Publications

Mustafa, R., Punihaole, D. “Characterizing the Formation of Polyethyleneimine-based Polymer-DNA Nanoparticle Complexes for Improved Gene and Drug Delivery Applications”. Harrick Scientific. Polyethyleneimines & ATR-IR: Advancing Gene Delivery - Specac Ltd.

Mustafa, R.; Diorio, D.; Harper, M.; Punihaole, D*. “Revealing Two Distinct Molecular Binding Modes in Polyethyleneimine-DNA Polyplexes Using Infrad Spectroscopy”. Soft Matter. 2025.

Martell, M.; Mendez, N.; Kumar, S.; Muller, A.; Hurd, G.; Sebastian, V.; Punihaole, D.; Mustafa, R.; Aheran, L.; Benicewicz, B.; Ly, R.; Lin, H.; Sansoz, F.; Schadler, L*. “Effects of crystallization on micro-mechanical behavior of polyethylene nanocomposites using Raman spectroscopy”. Nanocomposites. 2025. http://dx.doi.org/10.1080/20550324.2025.2471679.

Mustafa, R.; Fitian, M.; Hamilton, N.B.; Li, J.; Silva, W.R.; Punihaole, D.* “Molecular Insights into the Binding of Linear Polyethyleneimines and single-stranded DNA Using Raman Spectroscopy: A Quantitative Approach.” Journal of Physical Chemistry B. 2022.

Presentations

Mustafa, R. Polymeric Vectors for Gene Therapy Applications: An In-Depth Structural Analysis of Nucleic Acid Interactions Using Vibrational Spectroscopy. Oral presentation. Pittcon, Boston, MA, 2025.

Mustafa, R. Molecular Insights into the Binding of Linear Polyethyleneimines and single-stranded DNA Using Raman Spectroscopy. Oral presentation. SciX, Reno, NV, 2023.

Mustafa, R. Molecular Insights into the Binding of Linear Polyethyleneimines and single-stranded DNA Using Raman Spectroscopy. Poster presentation. American Chemical Society, Denver, CO, 2024.

Mustafa, R. Molecular Insights into the Binding of Linear Polyethyleneimines and single-stranded DNA Using Raman Spectroscopy. Poster presentation. Gordon Research Conference, Bryant University, RI, 2024.

Mustafa, R. Molecular Insights into the Binding of Linear Polyethyleneimines and single-stranded DNA Using Raman Spectroscopy. Poster presentation. Pittcon, Philadelphia, PA, 2023.

Mustafa, R. Molecular Insights into the Binding of Linear Polyethyleneimines and single-stranded DNA Using Raman Spectroscopy. Poster presentation. Polymer in Medicine and Biology: ACS POLY Workshop, Napa, CA, 2022.

Mustafa, R. Molecular Insights into the Binding of Linear Polyethyleneimines and single-stranded DNA Using Raman Spectroscopy. Poster presentation. Vermont Center for Cardiovascular and Brain Health Symposium, Burlington, VT, 2022.