**Divita MATHUR**
Assistant Professor
Dept of Chemistry, Millis G22B
Case Western Reserve University
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## Current Appointments

07/2022 – Assistant Professor, Dept of Chemistry, Case Western Reserve University, Cleveland, OH
- Merge the architectural and biological properties of nucleic acids for biomedical and nanoscale applications.

## Education

Iowa State University, Ames, IA — Ph.D., 2010-2016
Major: Bioinformatics & Computational Biology
Dissertation: *Dynamic Self-Assembling DNA Nanosystems: Design and Engineering.*

Delhi Technological University, New Delhi, India — B.E., 2006-2010
Major: Biotechnology

## Previous Research & Professional Experience

2016 – 2022 Navy Contractor Scientist, Center for Bio/Molecular Science and Engineering, US Naval Research Laboratory, Washington, DC
- Team member of a group focussed on the development of high efficiency bio-inspired light-harvesting networks, and novel biomaterial sensors based on the interface of optically active components and biological moieties.

2016 – 2022 Postdoctoral Scientist, College of Science, George Mason University, Fairfax, VA
*Advisors: Dr. Igor Medintz & Dr. Joel Schnur*
- Development of bio-mimetic DNA-based nanoscale substrates for harnessing energy transfer in optically-active dyes.
- Facile organization of inorganic nanoparticles for enhanced plasmonic and photonic abilities.

2011 – 2016 Graduate Research Assistant, Department of Genetics, Development, and Cell Biology, Iowa State University, Ames, IA
*Advisors: Dr. Eric Henderson & Dr. Jack Lutz*
- Facile and scalable engineering of DNA nanostructures using DNA *scaples*.
- Engineering of a dynamic DNA nanosystem for interrogating molecular interactions.

2009 Undergraduate Summer Trainee, University of Nebraska, Lincoln, NE
*Advisor: Dr. Vadim Gladyshev*
- *In silico* identification of key conserved sequences in genome assemblies that indicate telomeric length changes.

2008 Undergraduate Summer Trainee, The Indian Institute of Technology, Roorkee, India
*Advisor: Dr. Ritu Barthwal*
- Characterization of a DNA palindromic sequence using correlation spectroscopy.

**Current & Previous Funding**

2022 – 2025 NIH K99/R00 Pathway to Independence Award
- IC: National Institute of Biomedical Imaging and Bioengineering
- Award No: R00EB030013-03
- Title: *Cytosolic Access and Instability of DNA nanoparticles*
- The goals of this project are to study the cytosolic access and stability of DNA nanoparticles by the integration of calcium and use of noncanonical nucleic acids, and identify the rate of breakdown and mechanisms of stabilization of DNA nanoparticles in the cell cytosol.
- Role: Principal Investigator
- Annual cost (with IDC): $249,000

2021 – 2022 NIH K99/R00 Pathway to Independence Award
- IC: National Institute of Biomedical Imaging and Bioengineering
- Award No: 1K99EB030013-01A1
- Title: *Cytosolic Access and Instability of DNA nanoparticles*
- The goals of this project are to study the cytosolic access and stability of DNA nanoparticles by the integration of calcium and use of noncanonical nucleic acids, and identify . the rate of breakdown and mechanisms of stabilization of DNA nanoparticles in the cell cytosol.
- Role: Principal Investigator
- Annual direct cost: $86,000 (K99 Phase)

2020 – 2021 US Department of the Navy
- Award No: N00173-20-2-C006
- Title: *Innovative Solutions to Important Research Issues in Bio/Molecular Science and Engineering*
- This project investigated the areas of biomaterials, biomedical sensors, bio/molecular interactions and their applications. The project focussed on the development of biosensors and microfluidic devices; fabrication of nano alloys, controlled release materials, fuel cells and other novel materials.
- Role: Co-Principal Investigator
- Annual direct cost: $2,051,281

**Publications (Citations: 450; h-index: 15)**

**Journal Articles**

1. Huff, J.S., Díaz, S.A., Barclay, M.S., Chowdhury, A.U., Chiriboga, M., Ellis, G.A., **Mathur, D.**, Patten, L.K., Roy, S.K., Sup, A., Biaggne, A., Rolczynski, B.S., Cunningham, P.D., Li, L., Lee, J., Davis, P.H., Yurke, B., Knowlton, W.B., Medintz, I.L., Turner, D.B., Melinger, J.S., Pensack, R.D., *Tunable Electronic Structure via DNA-Templated Heteroaggregates of Two Distinct Cyanine Dyes.* **The Journal of Physical Chemistry C** 2022 DOI: 10.1021/acs.jpcc.2c04336. Impact Factor: 4.126.

2. **Mathur, D.**, Rogers, K.E., Díaz, S.A., Muroski, M.E., Klein, W.P., Nag, O.K., Lee, K., Field, L.D., Delehanty, J.B., Medintz, I.L., *Determining the Cytosolic Stability of Small DNA Nanostructures in Cellula.* **Nano Letters** 2022 DOI: 10.1021/acs.nanolett.2c00917. IF: 11.19. **Journal Cover.**

3. Chowdhury, A.U., Díaz, S.A., Huff, J.S., Barclay, M.S., Chiriboga, M., Ellis, G.A., **Mathur, D.**, Patten, L.K., Sup, A., Hallstrom, N., Cunningham, P.D., Lee, J., Davis, P.H., Turner, D.B., Yurke, B., Knowlton,

W.B., Medintz, I.L., Melinger, J.S., Pensack, R.P., *Tuning between Quenching and Energy Transfer in DNA-Templated Heterodimer Aggregates.* **The Journal of Physical Chemistry Letters** 2022 DOI:10.1021/acs.jpclett.2c00017. IF: 6.475.

4. Meares, A., Susumu, K., **Mathur, D.**, Lee, S.H., Mass, O.A., Lee, J., Pensack, R.D., Yurke, B., Knowlton, W.B., Melinger, J.S., Medintz, I.L., *Synthesis of Substituted Cy5 Phosphoramidite Derivatives and Their Incorporation into Oligonucleotides Using Automated DNA Synthesis.* **ACS Omega** 2022 DOI:10.1021/acsomega.1c06921. IF: 3.512.

5. Chiriboga, M.C., Green, C.M., Hastman, D.A., **Mathur, D.**, Wei, Q., Díaz, S.A., Medintz, I.L., Veneziano, R., *Rapid DNA origami nanostructure detection and classification using the YOLOv5 deep convolutional neural network.* **Scientific Reports** 2021 DOI:10.1038/s41598-022-07759-3. IF: 4.379.

6. Chiriboga, M.C., Díaz, S.A., **Mathur, D.**, Hastman, D.A., Melinger, J.S., Veneziano, R., Medintz, I.L., *Understanding Self-Assembled Pseudoisocyanine Dye Aggregates in DNA Nanostructures and Their Exciton Relay Transfer Capabilities.* **The Journal of Physical Chemistry B** 2021 DOI:10.1021/acs.jpcb.1c09048. IF: 2.991. **Journal Cover.**

7. **Mathur, D.***; Samanta, A.*; Ancona, M.*; Díaz, S.A.; Kim, Y.C.; Melinger, J.S.; Goldman, E.R.; Sadowski, J.P.; Ong, L.L.; Yin, P.; Medintz, I.L., *Understanding Förster Resonance Energy Transfer in the Sheet Regime with DNA Brick-Based Dye Networks*. **ACS Nano** 2021, **15** (10), 16452–16468. IF: 15.88. *Equal contribution.

8. Cunningham, P. D.*; Spillmann, C. M.*; Melinger, J. S.; Ancona, M. G.; Kim, Y. C.; **Mathur, D.**; Buckhout-White, S.; Goldman, E. R.; Medintz, I. L., *Förster Resonance Energy Transfer in Linear DNA Multifluorophore Photonic Wires: Comparing Dual versus Split Rail Building Block Designs*. **Advancd Optical Materials** 2021, **9**, 2100884. IF: 9.9. *Equal contribution. **Journal Cover.**

9. Green, C. M.*; Hastman, D. A.*; **Mathur, D.**; Susumu, K.; Oh, E.; Medintz, I. L.; Díaz, S. A., *Direct and Efficient Conjugation of Quantum Dots to DNA Nanostructures with Peptide-PNA*. **ACS Nano** 2021, **15** (5), 9101-9110. IF: 15.88. *Equal contribution.

10. **Mathur, D.**; Kim, Y. C.; Díaz, S. A.; Cunningham, P. D.; Rolczynski, B. S.; Ancona, M. G.; Medintz, I. L.; Melinger, J. S., *Can a DNA Origami Structure Constrain the Position and Orientation of an Attached Dye Molecule?* **The Journal of Physical Chemistry C** 2021, **125** (2), 1509-1522. IF: 4.1. **Journal Cover**.

11. Hastman, D. A.; Melinger, J. S.; Aragones, G. L.; Cunningham, P. D.; Chiriboga, M.; Salvato, Z. J.; Salvato, T. M.; Brown, C. W., 3rd; **Mathur, D.**; Medintz, I. L.; Díaz, S.A., *Femtosecond Laser Pulse Excitation of DNA-Labeled Gold Nanoparticles: Establishing a Quantitative Local Nanothermometer for Biological Applications*. **ACS Nano** 2020, **14** (7), 8570-8583. IF: 15.88.

12. Mazuski, R. J.; Díaz, S. A.; Wood, R. E.; Lloyd, L. T.; Klein, W. P.; **Mathur, D.**; Melinger, J. S.; Engel, G. S.; Medintz, I. L., *Ultrafast Excitation Transfer in Cy5 DNA Photonic Wires Displays Dye Conjugation and Excitation Energy Dependency*. **The Journal of Physical Chemistry Letters** 2020, **11** (10), 4163-4172. IF: 6.71.

13. Brintlinger, T. H.; Buckhout-White, S.; Bassim, N. D.; **Mathur, D.**; Samanta, A.; Robinson, J. T.; Idrobo, J.-C.; Stroud, R. M.; Goldman, E. R.; Ancona, M. G., *Chemical Mapping of Unstained DNA Origami Using STEM/EDS and Graphene Supports*. **ACS Applied Nano Materials** 2020, **3** (2), 1123-1130. IF: 3.9.

14. Green, C. M.; **Mathur, D.**; Medintz, I. L., *Understanding the Fate of DNA Nanostructures inside the Cell*. **The Journal of Materials Chemistry B** 2020, **8** (29), 6170-6178. IF: 5.0. **Journal Cover**.

15. **Mathur, D.***; Klein, W. P.*; Chiriboga, M.; Bui, H.; Oh, E.; Nita, R.; Naciri, J.; Johns, P.; Fontana, J.; Díaz, S. A., et al., *Analyzing Fidelity and Reproducibility of DNA Templated Plasmonic Nanostructures*. **Nanoscale** 2019, **11** (43), 20693-20706. IF: 6.8. *Equal contribution.

16. **Mathur, D.**; Medintz, I. L., *The Growing Development of DNA Nanostructures for Potential Healthcare-Related Applications*. **Advanced Healthcare Materials** 2019, **8** (9), e1801546. IF: 7.3. **Journal Cover.**

17. Cunningham, P. D.; Kim, Y. C.; Díaz, S. A.; Buckhout-White, S.; **Mathur, D.**; Medintz, I. L.; Melinger, J. S., *Optical Properties of Vibronically Coupled Cy3 Dimers on DNA Scaffolds*. **The Journal of Physical Chemistry B** 2018, **122** (19), 5020-5029. IF: 2.8.

18. Toeppa, A.J.; Schauta, R.G.; Scotta, B.D.; **Mathur, D.**; Berens, A.J.; Petersen, C.A., *Leishmania Incidence and Prevalence in U.S. Hunting Hounds Maintained via Vertical Transmission*. **Veterinary Parasitology: Regional Studies and Reports** 2017, **10**, 75-81. IF: 1.73.

19. **Mathur, D.***; Samanta, A.*; Oh, E.; Díaz, S. A.; Susumu, K.; Ancona, M. G.; Medintz, I. L., *Quantum Dot Encapsulation Using a Peptide-Modified Tetrahedral DNA Cage*. **Chemistry of Materials** 2017, **29** (14), 5762-5766. IF: 9.5. *Equal contribution.

20. **Mathur, D.**; Medintz, I. L., *Analyzing DNA Nanotechnology: A Call to Arms for the Analytical Chemistry Community*. **Analytical Chemistry** 2017, **89** (5), 2646-2663. IF: 6.7. **Journal Cover**.

21. **Mathur, D.**; Henderson, E. R., *Programmable DNA Nanosystem for Molecular Interrogation*. **Scientific Reports** 2016, **6**, 27413. IF: 3.9.

22. **Mathur, D.**; Henderson, E. R., *Complex DNA Nanostructures from Oligonucleotide Ensembles*. **ACS Synthetic Biology** 2012, **2** (4), 180 - 185. IF: 5.5.

**Proceedings**

1. **Mathur, D.**, Kim, Y.C., Díaz, S. A., Ellis, G. A., Cunningham, P. D., Rolczynski, B. S., Ancona, M. G., Medintz, I. L., and Melinger, J. S.. 2021. *Exploring the Holliday Junction in a DNA nanostructure for creating excitonic dimers*. In **2021 IEEE 21st International Conference on Nanotechnology** (NANO). 360-363.

2. Green, C.M., Hastman, D. A., **Mathur, D.**, Susumu, K., Medintz, I. L., and Díaz, S. A. 2021. *Parameters guiding the self-assembly of quantum dots and DNA origami by peptide-PNA*. In **2021 IEEE 21st International Conference on Nanotechnology** (NANO). 448-450.

3. **Mathur, D.**; Klein, W.P.; Bui, H.; Oh, E.; Naciri, J.; Fontana, J.; Díaz, S.A.; Medintz, I.L., *Competitive Binding of Golf Nanospheres and Nanorods on DNA Origami Substrates*. **Colloidal Nanoparticles for Biomedical Applications**, XV 11255, 1125509.

4. Koehler, C.; **Mathur, D.**; Henderson, E.; Lutz, R., *Probing the Security of DNA Origami*. **2018 IEEE International Symposium on Software Reliability Engineering Workshops** 2018, 138-139.

5. Tun, T.T.; Lutz, R.; Nakayama, B.; Yu, Y.; **Mathur, D.**; Nuseibeh, B., *The Role of Environmental Assumptions in Failures of DNA Nanosystems*. **2015 IEEE/ACM International Workshop on Complex Faults and Failures in Large Software Systems** 2015, 27-33.

6. Ellis, S. J.; Henderson, E. R.; Klinge, T. H.; Lathrop, J. I.; Lutz, J. H.; Lutz, R. R.; **Mathur, D.**; Miner, A. S. *Automated Requirements Analysis for a Molecular Watchdog Timer*, **Proceedings of the 29th ACM/IEEE international conference on Automated software engineering**, ACM: 2014; pp 767-778.

7. Lutz, R. R.; Lutz, J. H.; Lathrop, J. I.; Klinge, T. H.; **Mathur, D.**; Stull, D. M.; Bergquist, T. G.; Henderson, E. R. *Requirements Analysis for a Product Family of DNA Nanodevices*, 2012 **20th IEEE International Requirements Engineering Conference (RE)**, IEEE: 2012; pp 211-220.

8. Lutz, R.; Lutz, J.; Lathrop, J.; Klinge, T.; Henderson, E.; **Mathur, D.**; Sheasha, D.A., *Engineering and Verifying Requirements for Programmable Self-Assembling Nanomachines*. **34th IEEE International Conference on Software Engineering** 2012, 1361-1364.

**Book Chapters**

1. Green, C.M., **Mathur, D.**, Susumu, K., Oh, E., Medintz, I.L., Diaz, S.A., 2022, *Polyhistidine-Tag-Enabled Conjugation of Quantum Dots and Enzymes to DNA Nanostructures*, **Bioluminescence, Springer Nature.**

**Teaching & Mentoring Experience**

1. Fall 2022 CHEM 304 Quantitative Analysis Laboratory.

2. Graduate Teaching Assistant, Human Anatomy (GDCB255L) & Physiology (GDCB256L) laboratories, Iowa State University, 2014-2015; Average instructor rating = 4.6/5.

3. Mentoring activity (*co-authored publications.)

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|---|---|---|---|
| Puja Bhavsar | Highschool Senior | International Academy East | 2022- |
| Zach Schmalz | Undergraduate Sophomore | Case Western Reserve Univ. | 2022- |
| Nandana Vinod | Undergraduate Sophomore | Case Western Reserve Univ. | 2022- |
| Kevin Liu | Undergraduate Senior | Case Western Reserve Univ. | 2022- |
| Angelica Galvan | Graduate student (PhD) | University of Maryland | 2022- |
| Jameel Kelley | Graduate student (Masters) | Iowa State University | 2021-22 |
| Katherin Rogers* | Graduate student (PhD) | University of Maryland | 2020-22 |
| Matthew Chiriboga* | Graduate student (PhD) | George Mason University | 2018-22 |
| David Hastman* | Graduate student (PhD) | University of Maryland | 2018-21 |
| Yeonwoo Kim | Highschool Senior | Thomas Jefferson High School | 2018 |
| Chase Koehler* | Undergraduate Junior | Iowa State University | 2015-16 |
| Gabrielle Ortman | Undergraduate Junior | Iowa State University | 2015-16 |
| Brian Nakayama* | Graduate student (Masters) | Iowa State University | 2014-15 |
| Michael McKinney | Undergraduate Sophomore | Denison University | 2013 |

4. Guest lecturer, *Naval Research Enterprise Internship Program*, **The American Society for Engineering Education** with Dr Igor Medintz, 2020, 2021.

5. **NSF** Panelist, *Emerging Researchers National Conference* 2018.

6. Trained under **Project LEA/RN workshop**, Iowa State University, 2015

**Honors & Awards**

1. Article *Direct and Efficient Conjugation of Quantum Dots to DNA Nanostructures with Peptide-PNA* received the NRC/ASEE Postdoctoral Research Publication Award at the US Naval Research Laboratory, 2022.

2. Article *Förster Resonance Energy Transfer in Linear DNA Multifluorophore Photonic Wires: Comparing Dual versus Split Rail Building Block Designs* received the Annual Research Publication Award at the US Naval Research Laboratory, 2022.

3. Article *Femtosecond Laser Pulse Excitation of DNA-Labeled Gold Nanoparticles: Establishing a Quantitative Local Nanothermometer for Biological Applications* received the Alan Berman Research Publication Award at the US Naval Research Laboratory, 2021.

4. Article *Understanding the Fate of DNA Nanostructures inside the Cell* featured in the Journal of Materials Chemistry B HOT papers.

5. Article *The Growing Development of DNA Nanostructures for Potential Healthcare-Related Applications* featured in the WBC2020 – Advanced Biomaterials special issue.

6. The James Cornette Travel Award, Bioinformatics & Computational Biology Program, Iowa State University, 2015.

7. Conference paper *Automated Requirements Analysis for a Molecular Watchdog Timer* received the IFIP TC2 Manfred Paul Award for Excellence in Software: Theory and Practice.

8. The James Cornette Travel Award, Bioinformatics & Computational Biology Program, Iowa State University, 2015.

9. The Departmental Services Award, Genetics Development & Cell Biology Department, Iowa State University, 2014.

10. The James Cornette Research Fellowship ($4000 summer support), Bioinformatics & Computational Biology Program, Iowa State University, 2014, 2012.

11. Best student seminar, Bioinformatics & Computational Biology Program, Iowa State University, 2014.

**Review & Editorial Activities**

1. NSF proposal reviewer for the EFRI panel.

2. *Ad hoc* referee for
   (a) AAAS *Science*
   (b) ACS *Applied Materials & Interfaces*, *Chemical Biology*, *Applied Nano Materials*, *Analytical Chemistry*
   (c) Wiley *Particle & Particle Systems Characterization*, *ChemPlusChem*, *ChemistrySelect*, *Small*
   (d) RSC *Chemical Science*, *The Journal of Materials Chemistry B*
   (e) Elsevier *Biomembranes*, *Journal of Photochemistry & Photobiology, A: Chemistry*, *Chemical Physics*
   (f) Springer *Silicon*
   (g) Springer Nature *Scientific Reports*
   (h) Other referee activities include AIP, book proposals, university grants, etc.

3. Topic Editor, MDPI *Biosensors*.

4. Graduate Student Representative for faculty search committee, *Physical Biology of the Cell*, 2015.

**Conference & Seminar Activities**

1. Conference organization:
   - Co-session Chair, **Department of Defense Conference**, US Naval Research Laboratory, Washington DC, USA, 2022.
   - Session Chair, *Biomedical Applications of Plasmonic Nanoparticles II*, **SPIE Photonics West**, San Francisco, CA, USA, 2020.

- Co-organizer, **the Mid-Atlantic DNA Nanotechnology Symposium**, National Institutes of Standards and Technology, Gaithersberg, MD USA, 2017, 2019, & 2022.

2. Invited oral presentations:
   - *DNA Origami*, **CWRU Origins Science Scholars Program**, Case Western Reserve University (in-person), Cleveland, OH, USA, 2022.
   - *The cytosolic stability of DNA nanostructures*, **Global Nanobiotechnology Consortium**, University of South Florida (virtual & in-person), FL, USA, 2022.
   - *Synthetic DNA Nanostructures as Platforms for Precise Nanoparticle Organization*, **Case Western Reserve University Dept of Chemistry**, Cleveland, OH, USA, 2021.
   - *Can a DNA nanostructure constrain the position and orientation of an attached dye molecule?*, **Laboratory for Molecular Programing**, Iowa State University, IA, USA, 2021.
   - *Enzyme-controlled release of QD in a DNA icosahedron*, **SPIE Photonics West Conference**, San Francisco, CA, USA, 2020.
   - *DNA self-assembly: A nanoscale building block for bottom-up fabrication*, **George Mason University Department of Physics**, Fairfax, VA, USA, 2018.
   - *DNA Nanotechnology: The Programmable Building Block of Life*, **Simpson College**, Indianola, IA, 2014.

3. Contributed oral presentations:
   - *Identifying the cytosolic fate of DNA nanostructures*, **2021 TechConnect World**, National Harbor, MD, USA, 2021.
   - *Multiplexed Biosensing with Quantum Dots and Cell-Free Systems*, **Engineering and Utilizing Biological Sensors in the CASBAH: current efforts and future directions**, Virtual, 2021.
   - *Can a DNA nanostructure constrain the position and orientation of an attached dye molecule?*, **The 21st IEEE International Conference on Nanotechnology**, 2021.

4. Contributed poster presentations (limited to presenting author posters):
   - Mathur, D.; Kim, Y. C.; Díaz, S. A.; Cunningham, P. D.; Rolczynski, B. S.; Ancona, M. A.; Medintz, I. L.; Melinger, J. S., *Can a DNA Nanostructure Constrain the Position and Orientation of an Attached Dye Molecule?* In **Foundations of Nanosciences**, Virtual, 2021.
   - Mathur, D.; Muroski, M.; Díaz, S. A.; Klein, W.; Field, L.; Delehanty, J. B.; Medintz, I. L., *The Physiological Fate of DNA Crosshairs in the Cell Cytosol*. In **Mid-Atlantic DNA Nanotechnology** (MADNano), 2019.
   - Mathur, D.; Samanta, A.; Oh, E.; Díaz, S. A.; Susumu, K.; Ancona, M. A.; Medintz, I. L., *Quantum Dot Encapsulation Using a Peptide-Modified Tetrahedral DNA Cage*. In **Foundations of Nanosciences**, Snowbird, Utah, USA, 2017.
   - Mathur, D.; Buckhout-White, S.; Person, C.; Chapin, A. A.; Goldman, E.; Medintz, I. L., *Coding DNA Restriction into Dynamic Nanosystems: Merging Molecular Logic with Synthetic Biology*. In **DNA23**, Austin, Texas, USA, 2017.
   - Mathur, D.; Henderson, E. R., *Autonomous DNA Nanosystem for Interrogating Molecular Interactions*. In **Synthetic Biology: Engineering, Evolution & Design** (SEED), Boston, Massachusetts, USA, 2015.
   - Mathur, D.; Henderson, E. R., *Deconstructing DNA Origami: Eliminating the Scaffold*. In **Foundations of Nanosciences**, Snowbird, Utah, USA, 2012.