

DEEPAK P. KOIRALA**EDUCATION**

Ph.D.	2014	Kent State University, Chemistry (Biophysical Chemistry)
M.Sc.	2005	Tribhuvan University (Nepal), Chemistry (Physical Chemistry)
B.Sc.	2002	Tribhuvan University (Nepal), Chemistry and Biology

Experience in Higher Education

August 2020 – present	University of Maryland Baltimore County, Assistant Professor, Chemistry and Biochemistry
2014 – 2020	The University of Chicago, Postdoctoral Scholar, Biochemistry and Molecular Biology
2008 – 2014	Kent State University, Ph.D. Student, Biophysical Chemistry
2008 – 2014	Kent State University, Teaching Assistant, General Chemistry
2005 – 2008	Tribhuvan University, Assistant Lecturer, Physical Chemistry

Experience in Other than Higher Education

2022 – present	Nepalese Students Association at UMBC, Faculty Advisor
2012 – 2013	Nepalese Students Association at Kent State University, President
2008 – 2009	Nepalese Students Association at Kent State University, Vice-President
2003 – 2004	Chemistry Students Association at Tribhuvan University, Chief Election Commissioner
2003 – 2004	Annual Science Magazine of Chemistry Students Association at Tribhuvan University, Coordinator

Honors Received

2023	CAREER Award, National Science Foundation (NSF)
2023	Collaborative Development Award, CRNA
2021	Strategic Awards for Research Transitions (START), UMBC
2021	Summer Research Faculty Fellowship (SURFF), UMBC
2013	Taylor Scholarship for Graduate Research, Kent State University
2013	GSS Domestic Travel Grant, Kent State University
2012	University Fellowship, Kent State University

2008	Pandit Narayan Prasad Upadhaya Award, Nepal Chemical Society
2006	P.M. Singh Gold Medal, Tribhuvan University, Nepal
2006	Amrit Gold Medal, Tribhuvan University, Nepal
2005	Kirti-Sanu Gold Medal, Shesh-Hira Pratisthan, Nepal
2003	Harihar Raj Lohani Award, Nepal Chemical Society
1999 – 2004	University Scholarship, Tribhuvan University, Nepal

Research Support and Fellowships

2023 – present	Structural studies of HIV-1 RRE and FSE using Fab-assisted RNA crystallography, NIAID (1U54AI170660), Sub-award SUBK00019302, Center for Structural Biology of HIV RNA (CRNA) Collaborative Development Award, \$220,000 (direct costs), P.I.
2023 – present	Structural and mechanistic studies of cap-independent genome translation in (+)-strand RNA viruses, NIH MIRA R35GM150869, \$1,250,000 (direct costs), P.I.
2023 – present	Structural and mechanistic studies of RNA-mediated enteroviral genome replication, NSF CAREER (MCB-2236996), \$565,266 (direct costs), P.I.
2021 – 2022	Roles of structured RNA elements in viral cap-independent translation, \$25,000 (direct costs), UMBC START, P.I.
2021 – 2022	Roles of structured RNA elements in viral cap-independent translation, \$6,000 (direct costs), UMBC SURFF, P.I.
2020 – 2025	RNA structures, their functions, and therapeutic implications, \$653,000 (direct costs), UMBC Start-up, P.I.

PUBLICATIONS, PRESENTATIONS, AND CREATIVE ACHIEVEMENTS

Publications

Since 2020, after joining UMBC (* indicates undergraduates)

1. Das N.K., Vogt J,* Patel A.,* Al Banna H., **Koirala D.**, Structural basis for a highly conserved RNA-mediated enteroviral genome replication, *Nucleic Acids Res.*, **2024**, gkae627.
2. Ojha M., Vogt J.,* Das N.K., Redmond E.,* Singh K., Al Banna H., Sadat T.,* **Koirala D.**, Structure of saguaro cactus virus 3' translational enhancer mimics 5' cap for eIF4E binding, *Proceedings of the National Academy of Sciences*, **2024**, 121 (4), e2313677121.
3. Al Banna, H., Das, N. K., Ojha, M., **Koirala D.** Advances in chaperone-assisted RNA crystallography using synthetic antibodies. *BBA advances*, **2023**, 100101.

4. Das, N. K., Hollmann, N. M., Vogt, J.,* Sevdalis, S. E., Banna, H. A., Ojha, M., **Koirala D.**, Crystal structure of a highly conserved enteroviral 5' cloverleaf RNA replication element. *Nat. Commun.*, **2023**, 14(1), 1955.
5. Krochmal D., Shao Y., Li N.S., DasGupta S., Shelke S.A., **Koirala D.**, Piccirilli J.A., Structural basis for substrate binding and catalysis by a self-alkylating ribozyme, *Nat. Chem. Biol.*, **2022**, 18, 376–384 (co-corresponding author).
6. Rees H.C., Gogacz W., Li N.S., **Koirala D.**, Piccirilli J.A., Structural basis for fluorescence activation by pepper RNA, *ACS Chem. Biol.* **2022**, 17 (7) 1866–1875.
7. Swain M., Ageeli A.A., Kasprzak W.K., Li M., Miller J.T., Sztuba-Solinska J., Schneekloth J.S., **Koirala D.**, Piccirilli J.A., Fraboni A.J., Murelli R.P., Wlodawer A., Shapiro B.A., Baird N., Le Grice S.F.J., Dynamic bulge nucleotides in the KSHV PAN ENE triple helix provide a unique binding platform for small molecule ligands, *Nucleic Acids Res.*, **2021**, 49(22):13179-13193.
8. Roman C., Lewicka A., **Koirala D.**, Li N.S. & Piccirilli J.A., The SARS-CoV-2 programmed -1 ribosomal frameshifting element crystal structure solved to 2.09 Å using chaperone-assisted RNA crystallography, *ACS Chem. Biol.* , **2021**, 16, 1469-1481

Before joining UMBC

9. **Koirala D.**, Lewicka A., Koldobskaya Y., Huang H. & Piccirilli J.A., Synthetic antibody binding to a preorganized RNA domain of hepatitis C virus internal ribosome entry site inhibits translation, *ACS Chem. Biol.*, **2020**, 15 (1), 205-216.
10. **Koirala D.**, Shao Y., Koldobskaya Y., Fuller J. R., Watkins A.M., Shelke S.A., Pilipenko E.V., Das R., Rice P.A. & Piccirilli J. A., A conserved RNA structural motif for organizing topology within picornaviral internal ribosome entry sites, *Nat. Commun.*, **2019**, 10:3629.
11. **Koirala D.**, Shelke S.A., Dupont M., Ruiz S., Dasgupta S., Bailey L.J., Benner S.A. & Piccirilli J.A., Affinity maturation of a portable Fab-RNA module for chaperone-assisted RNA crystallography, *Nucleic Acids Res.*, **2018**, 46(5), 2624 – 2635.
12. Shelke S.A., Shao Y., Laski A., **Koirala D.**, Weissman B.P., Fuller J.R., Tan X., Constantin T.P., Waggoner A.S., Bruchez M.P., Armitage B.A. & Piccirilli J.A., Structural basis for activation of fluorogenic dyes by an RNA aptamer lacking a G-quadruplex motif, *Nat. Commun.*, **2018**, 9:4542.
13. **Koirala D.**, Shrestha P., Emura T., Hidaka K., Mandal S., Masayuki E., Sugiyama H. & Mao H., Single molecule mechanochemical sensing using DNA origami nanostructures, *Angew. Chem. Int. Ed. Engl.*, **2014**, 53, 8137 – 8141 (Journal's cover story).
14. **Koirala D.**, Punnoose J.A., Shrestha P. & Mao H., Yoctoliter thermometry for single-molecule investigations: a generic bead-on-a-tip temperature-control module, *Angew. Chem. Int. Ed. Engl.*, **2014**, 53, 3470 – 3474 (Journal's cover story & research highlights in Nat. Nanotechnology).
15. **Koirala D.**, Ghimire C., Bohrer C., Sannohe Y., Sugiyama H. & Mao H., Long-loop G-quadruplexes are misfolded population minorities with fast transition kinetics in human telomeric sequences, *J. Am. Chem. Soc.*, **2013**, 135, 2235 – 2241.
16. **Koirala D.**, Mashimo T., Sannohe Y., Yu Z., Mao H. & Sugiyama H., Intramolecular folding in three tandem guanine repeats of human telomeric DNA, *Chem. Commun.*, **2012**, 48, 2006 – 2008.

17. **Koirala D.**, Dhakal S., Ashbridge B., Sannohe Y., Rodriguez R., Sugiyama S., Balasubramanian S. & Mao H., A single-molecule platform for investigation of interactions between G-quadruplexes and small-molecule ligands, *Nat. Chem.*, **2011**, 3, 782-787 (highlighted in Nature News & Views).
18. **Koirala D.**, Yu Z., Dhakal S. & Mao H., Detection of single nucleotide polymorphism using tension-dependent stochastic behavior of a single-molecule template, *J. Am. Chem. Soc.*, **2011**, 133, 9988-91.
19. Shrestha P., Emura T., **Koirala D.**, Cui Y., Hidaka K., Maximuck W.J., Endo M., Sugiyama H. & Mao H., Mechanical properties of DNA origami nanoassemblies are determined by Holliday junction mechanophores, *Nucleic Acids Res.*, **2016**, 44 (14), 6574-6582.
20. Mandal S., **Koirala D.**, Selvam S., Ghimire C. & Mao H., A molecular tuning fork in single molecule mechanochemical sensing, *Angew. Chem. Int. Ed. Engl.*, **2015**, 54(26):7607 – 1.
21. Jiang H.X., Cui Y., Zhao T., Fu H.W., **Koirala D.**, Punnoose J.A., Kong D.M. & Mao H., Divalent cations and molecular crowding buffers stabilize G-triplex at physiologically relevant temperatures, *Sci. Rep.*, **2015**, 5:9255.
22. Punnoose J.A., Cui Y., **Koirala D.**, Yangyuoru P.M., Ghimire C., Shrestha P. & Mao H., Interaction of G-quadruplexes in the full-length 3' human telomeric overhang, *J. Am. Chem. Soc.*, **2014**, 136, 18062 – 18069.
23. Selvam S., **Koirala D.**, Yu Z., & Mao H., Quantification of topological coupling between DNA superhelicity and G-quadruplex formation, *J. Am. Chem. Soc.*, **2014**, 136, 13967-13970.
24. Cui Y., **Koirala D.**, Kang H.J., Dhakal S., Yangyuoru P.M., Hurley L. H. & Mao H., Molecular population dynamics of DNA structures in a bcl-2 promoter sequence is regulated by small molecules and the transcription factor hnRNP LL, *Nucleic Acids Res.*, **2014**, 42, 5755 – 5764 (featured story in Chemical & Engineering News).
25. Ghimire C., **Koirala D.**, Mathis M.B., Kooijman E.E. & Mao H., Controlled particle collision leads to direct observation of docking and fusion of lipid droplets in an optical trap, *Langmuir*, **2014**, 30, 1370–1375 (key scientific article in Global Medical Discovery).
26. Yangyuoru P.M., Zhang A.Y., Shi Z., **Koirala D.**, Balasubramanian S. & Mao H., Mechanochemical properties of individual human telomeric RNA (TERRA) G-quadruplexes, *ChemBioChem*, **2013**, 14, 1931 – 1935.
27. Dhakal S., Cui Y., **Koirala D.**, Ghimire C., Kushwaha S., Yu Z., Yangyuoru P.M. & Mao H., Structural and mechanical properties of individual human telomeric G-quadruplexes in molecularly crowded solutions, *Nucleic Acids Res.*, **2013**, 41, 3915 – 3923
28. Yu Z., **Koirala D.**, Cui Y., Easterling L.F., Zhao Y. & Mao H., Click-chemistry assisted single-molecule fingerprinting reveals a 3D biomolecular folding funnel, *J. Am. Chem. Soc.*, **2012**, 134, 12338 – 12341
29. Yangyuoru P.M., Dhakal S., Yu Z., **Koirala D.**, Mwangela S.M. & Mao H., Single-molecule measurements of the binding between small molecules and DNA aptamers, *Anal. Chem.*, **2012**, 84, 5298 – 5303.
30. Dhakal S., Yu Z., Konik R., Cui Y., **Koirala D.** & Mao H, G-quadruplex and i-motif are mutually exclusive in double-stranded ILPR DNA, *Biophys J.*, **2012**, 102, 2575 – 2584.

31. Dhakal S., Lafontaine J.L., Yu Z., **Koirala D.** & Mao H., Intramolecular folding in human ILPR fragment with three C-rich repeats, *PLoS ONE*, **2012**, 7(6): e39271
32. Dhakal S., Schonhoft J.D., **Koirala D.**, Yu Z., Basu S. & Mao H., Coexistence of an ILPR i-motif and a partially folded structure with comparable mechanical stability revealed at single-molecule level, *J. Am. Chem. Soc.*, **2010**, 132, 8991 – 8997
33. **Koirala D.**, Yangyuoru P.M. & Mao H., Mechanical affinity as a new metrics to evaluate binding events, *Rev. Anal. Chem.*, **2013**, 32, 197 – 208 (invited, peer-reviewed)

Conference Proceedings

1. Das N.K., Hollmann N., **Koirala D.**, The crystal structure of coxsackievirus 5' RNA replication platform, *Acta Crystallographica A – foundation and advances*, 79, A330-A330, **2023**.
2. Ojha M., Redmond E., **Koirala D.**, The crystal structure of a PTE RNA element from a cactus virus that binds human eIF4E, *Journal of Biological Chemistry*, 299 (3), 104050, **2023**.
3. Al Banna H., Sadat T., **Koirala D.**, Synthetic anti-RNA antibody derivatives for RNA visualization in cells, *Journal of Biological Chemistry*, 299 (3), 104217, **2023**.
4. **Koirala D.**, Crystal structures of replication-linked RNAs from enteroviral genomes, *Acta Crystallographica Section A: Foundations of Crystallography*, 79, a156-a156, **2022**.
5. Al Banna H., Das N.K., **Koirala D.** Structural studies of domain IV RNA from type I picornaviral internal ribosome entry sites, *Acta Crystallographica Section A: Foundations of Crystallography*, 79, a344-a344, **2022**.
6. Roman C.A., **Koirala D.** & Piccirilli J.A., Crystalizing Structured RNAs Using a Surface-Entropy-Reduced Fab as a Crystallization Chaperone, Experimental Biology 2020 Meeting Abstracts, *The FASEB Journal*, **2020**.
7. Dhakal S., Yu Z., Konik R., **Koirala D.** & Mao H., Formation of human ILPR G-quadruplex in dsDNA, *I. Re. Bi. C.*, 2, 191 – 192, **2011**.

Patents

1. Mao H., **Koirala D.**, Sugiyama H., & Endo M., Mechanochemical sensing methods using DNA origami nanostructures, U.S. Patent Application No. 15/315, 856, **2015**.
2. Mao H., & **Koirala D.**, Devices and methods for detecting single nucleotide polymorphisms, U.S. Patent Application No. 13/485, 201, **2012**.

PRESENTATIONS

Conference Presentations

1. Fab-assisted RNA Structure Determination by X-ray Crystallography and CryoEM, *American Crystallographic Association 74th Annual Meeting*, Denver, July **2024**
2. Understanding RNA Structure-based strategies of viral genome translation and replication, *The 2024 FCBIS, UMBC*, May **2024**
3. Structural basis for RNA-mediated enteroviral genome replication, *4th conference on Biomotors, Virus assembly and Nanotechnology*, Columbus, December **2023**

4. Crystal Structures of replication-linked RNAs from enteroviral genomes, *American Crystallographic Association 73rd Annual Meeting*, Baltimore, July **2023**
5. Structural basis for RNA-based strategy of enteroviral genome replication, *Gordon Research Conference on RNA Nanotechnology*, Ventura, January **2023**
6. The crystal structures of replication-linked 5' cloverleaf RNAs from enteroviral genomes, *Pittcon Conference*, Philadelphia, March **2022**
7. Structural basis of RNA self-alkylation, *4th International Webinar on Nucleic Acids and CRISPR*, February 18-19, **2022**
8. Applications of anti-RNA antibodies for the crystallography of viral RNA domains and beyond, *Biomotors, Virus Assembly and Nanotechnology*, Columbus, July **2019**
9. Applications of anti-RNA antibodies for RNA crystallography and beyond, *Nucleosides, Nucleotides, and Nucleic Acids Gordon Research Conference*, Rhode Island, June **2019**
10. Crystal structure of an essential RNA domain from IRES of hepatitis A virus in complex with a synthetic antibody fragment, *23rd Annual Meeting of RNA Society*, Berkeley, June **2018**
11. New RNA structures using Fabs as crystallization chaperones, *Chicagoland RNA Club Meeting*, University of Chicago, March **2018**
12. Single-molecule measurements of the binding between small molecules and DNA aptamers, *Pittcon Conference*, Philadelphia, March **2013**
13. Dynamics of the structures formed in human telomeric DNA oligomers revealed by single-molecule optical-tweezers measurements, *Nucleosides, Nucleotides, and Nucleic Acids Gordon Research Conference*, Rhode Island, July **2013**
14. Studies on the determination of fluoride using ion selective electrode, *General assembly*, Nepal Chemical Society, Nepal, **2005**

Other Professional Presentations

1. Structural plasticity of HIV-1 RRE stem-loop II modulates Rev binding cooperativity and oligomerization, *Center for Structural Biology of HIV RNA (CRNA) Science Monthly*, July **2024**
2. Non-coding RNA structures associated with viral genome translation and replication, National Institute of Health (NIH), Bethesda, invited seminar, June **2024**
3. Structural Biology of RNA-mediated Viral Genome Replication and Translation, University of California Davis, Department of Biochemistry and Molecular Medicine, invited seminar, June **2024**
4. Structural Studies of HIV-1 RRE Using Fab-assisted RNA Crystallography, *Center for Structural Biology of HIV RNA (CRNA) Annual Retreat*, University of Michigan, October **2023**
5. Structural basis for RNA-based strategy of enteroviral genome replication, Biochemistry & Molecular Biology Retreat, UMB/UMBC GPLIS, invited seminar, January **2023**
6. Crystal structures of RNA domains that promote viral genome replication and translation, The George Washington University, Department of Chemistry, invited seminar, November **2022**

7. Understanding functional RNA structures using chaperone-assisted X-ray crystallography, *Department of Biochemistry and Molecular Biology, UMB*, invited seminar, April **2022**
8. RNA crystallography using synthetic antibodies as chaperones, *Department of Biophysics, Johns Hopkins University*, invited seminar, March **2021**
9. Optimization of a portable Fab – RNA module for chaperone-assisted RNA crystallography, *Department of Biochemistry & Molecular Biology, University of Chicago, Annual Retreat, Galena, IL*, October **2017**
10. Maturation of Fab-RNA binding affinity for chaperone-assisted RNA crystallization (CARC), *Chemistry-Biology Interface (CBI) Training Program, University of Chicago*, October **2015**
11. Controlled particle collision leads to direct observation of docking, hemifusion, and full fusion of lipid droplets in an optical trap, *American Chemical Society - Student Chapter, Kent State University & Stark State College, Second Annual Honors Week, Kent, OH*, April **2014**

SERVICE TO THE DEPARTMENT, UNIVERSITY, COMMUNITY, AND PROFESSION

2022 – 2024	Co-chair, Seminar Committee
Fall 2020 – present	Member, Graduate Recruitment Committee
2022 – present	Nepalese Students Association at UMBC, Faculty Advisor
Summer 2022 – present	Member, UMB/UMBC Biochemistry Graduate Education Committee
Spring 2024	Member of Organizing Committee, The FCBIS 2024
Spring 2023	Member of Organizing Committee at UMBC, Science Olympiad 2023
Fall 2022 – present	Member, American Crystallographic Association (ACA)
June 2015 – present	Member, RNA Society
Fall 2022 – present	Reviewer, NSF Grant Proposals
Fall 2020 – Fall 2022	Academic Guest Editor, <i>Genes</i> (ISSN 2073-4425), MDPI
Fall 2020 – Present	Reviewer of the following peer-reviewed journals (since 2020): <i>Nature Communications</i> , <i>Nature Structural & Molecular Biology</i> , <i>Proceedings of National Academy of Science</i> , <i>ACS Nano</i> , <i>ACS Omega</i> , <i>ACS Biochemistry</i> , <i>MDPI Cells</i> , <i>Frontiers in Molecular Biosciences</i> , <i>Royal Society Open Science</i> , <i>Elsevier Computational and Structural Biotechnology</i> , <i>ChemMedChem</i> , <i>The Journal of Visualized Experiments</i> , <i>PLoS One</i> , and <i>Microscopy Research and Technique</i>