Curriculum Vitae

Rubul Mout, PhD

Research Fellow
Stem Cell & Regenerative Biology Program,
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EDUCATION

- Ph.D., Chemistry, University of Massachusetts Amherst, MA, USA, 2017
- M.Sc., Chemistry, Gauhati University, Guwahati, India, 2006

RESEARCH STATEMENT

My research training has focused on protein design and engineering, immune development and signaling—particularly hematopoietic stem cell and T cell development—as well as nanotechnology. My current and future goal is to develop advanced protein design tools using computational and AI methods to tackle key challenges in immune signaling and rejuvenation, with a special interest in T cell development within the bone marrow and thymus during aging. Ultimately, I aim to enhance T cell function to better combat cancer, autoimmune diseases, and viral infections.

RESEARCH POSITIONS

- Fellow (Research), Harvard Medical School and Boston Children's Hospital, USA (2021-current) [Sponsor: George Daley, *Dean, Harvard Medical School*]
- Washington Research Foundation Postdoctoral Fellow, University of Washington, USA (2017-2021) [Mentor: David Baker, *Director, Institute for Protein Design, UW*]
- Senior fellow, University of Washington, USA (2017)
- Research assistant, University of Massachusetts Amherst, USA (2012-2017) [Advisor: Vincent M. Rotello]
- Visiting researcher, Glasgow University, Scotland (2014)
- Summer visiting researcher, Purdue University, USA (2008)
- Scientific officer (researcher), Tata Institute of Fundamental Research, Mumbai, India (2006-2010)

GRANT AND FUNDING

- Written the full proposal and secured a seed grant of $25,000. Principal Investigator: Vincent Rotello at UMASS Amherst (2015).
- Washington Research Foundation Fellowship. This foundation postdoctoral fellowship provided stipend plus $35,000 annual cost for research materials at University of Washington, USA (2017-2021).
- NIH T32 training grant (2021-2024).

SCIENTIFIC PUBLICATIONS

First-author papers:

1. **R Mout**, ... D Baker, SC Blacklow, GQ Daley *et al.*, "Design of soluble Notch agonists that drive T cell development and boost immunity", ***Cell***, 2025, DOI: 10.1016/j.cell.2025.07.009 (Featured in ***Nature***, 2024, 636(8041), 263-264)
2. **R Mout**[#], RC. Bretherton, J Decarreau, S Lee, N Gregory, NI Edman, M Ahlrichs, Y Hsia, DD Sahtoe, G Ueda, A Sharma, R Schulman, CA DeForest[#], D Baker[#] "De novo design of modular protein hydrogels with programmable intra- and extracellular viscoelasticity", ***Proc. Natl. Acad. Sci. U.S.A.***, 2024, 121(6), e2309457121 (#co-corresponding author)
3. Y Hsia*, **R Mout***, ..., D Baker. "Design of multi-scale protein complexes by hierarchical building block fusion" ***Nature communications***, 2021, 12, 2294 (*equal contribution)

4. YW Lee*, **R Mout***, ..., VM Rotello. "In Vivo Editing of Macrophages through Systemic Delivery of CRISPR-Cas9-Ribonucleoprotein-Nanoparticle Nanoassemblies", ***Adv. Therap***., 2019, *2*, 1900041 (*equal contribution)
5. **R Mout**, VM Rotello. "A General Method for Intracellular Protein Delivery through 'E-tag' Protein Engineering and Arginine Functionalized Gold Nanoparticles" ***Bio-protocol***, 2017, *7*, e2661.
6. **R Mout**, VM Rotello. "Cytosolic and Nuclear Delivery of CRISPR/Cas9-Ribonucleoprotein for Gene Editing using Arginine Functionalized Gold Nanoparticle" ***Bio-protocol***, 2017, *7*, e2586.
7. **R Mout**, M Ray, T Tray, K Sasaki, GY Tonga, VM Rotello. "General Strategy for Direct Cytosolic Protein Delivery via Protein-Nanoparticle Coengineering" ***ACS Nano***, 2017, *11*, 6416-6421.
8. **R Mout**, M Ray, Y-W Lee, F Scaletti, VM Rotello. "*In Vivo* Delivery of CRISPR/Cas9 for Therapeutic Gene Editing: Progress and Challenges" ***Bioconjug. Chem.***, 2017, *28*, 880-884.
9. **R Mout**, M Ray, GY Tonga, Y.-W. Lee, T Tray, K Sasaki, VM Rotello. "Direct Cytoplasmic Delivery of CRISPR/Cas9-Ribonucleoprotein for Efficient Gene Editing" ***ACS Nano***, 2017, *11*, 2452-2458.
10. **R Mout**, GY Tonga, L Wang, M Ray, T Roy, VM Rotello. "Programmed Self-Assembly of Hierarchical Nanostructures through Protein-Nanoparticle Coengineering" ***ACS Nano***, 2017, *11*, 3456-3462.
11. **R Mout**, GY Tonga, M Ray, DF Moyano, Y Xing, VM Rotello "Environmentally Responsive Histidine-Carboxylate Zipper Formation between Proteins and Nanoparticles" ***Nanoscale***, 2014, *6*, 8873-8877.
12. **R Mout**, VM Rotello. "Bio and Nano Working Together: Engineering the Protein-Nanoparticle Interface" ***Isr. J. Chem.***, 2013, *53*, 521-529.
13. **R Mout**, DF Moyano, S Rana, VM Rotello. "Surface Functionalization of Nanoparticles for Nanomedicine" ***Chem. Soc. Rev***., 2012, *41*, 2539-2544.
14. **R Mout**, Z Xu, AK Wolf, VJ Davisson, GK Jarori "Anti-Malarial Activity of Geldanamycin Derivatives in Mice Infected with *Plasmodium yoelii*" ***Malar J.***, 2012, *11*, 54.

Middle-author papers:

15. AP Patni, **R Mout**, R Moore, AA Alghadeer, GQ Daley, D Baker, J Mathieu, H Ruohola-Baker., "Designed Soluble Notch Agonist Drives Human Ameloblast Maturation for Tooth Regeneration" ***bioRxiv***, 2025, doi: https://doi.org/10.1101/2025.04.03.646929
16. B Huang, ... **R Mout**, ... C Bertozzi, D Baker. "Designed endocytosis-inducing proteins degrade targets and amplify signals" ***Nature***, 2025, 638(8051), 796-804.
17. M. Ray, G. Brancolini, DC Luther, Z. Jiang, R. Cao-Milán, AM Cuadros, A. Burden, V. Clark, S. Rana, **R Mout**, RF Landis, S. Corni, VM Rotello "High affinity protein surface binding through co-engineering of nanoparticles and proteins" ***Nanoscale***, 2022, *14*, 2411-2418.
18. M Ray, YW Lee, J Hardie, **R Mout**, GY Tonga, ME Farkas, VM Rotello "CRISPRed Macrophages for Cell-Based Cancer Immunotherapy" ***Bioconjugate Chem***., 2018, *29*, 445-450.
19. F Scaletti, D Luther, **R Mout**, M Ray, YW Lee, VM Rotello. "CRISPR/Cas9 Protein Delivery Technologies" ***G.I.T Laboratory Journal***, 2017, *21*, 22-23.
20. NDB Le, GY Tonga, **R Mout**, *et al*., "Cancer Cell Discrimination Using Host-Guest 'Doubled' Arrays" ***J. Am. Chem. Soc.***, 2017, *139*, 8008-8012.
21. K Saha, M Rahimi, M Yazdani, ST Kim, DF Moyano, S Hou, R Das, **R Mout**, F Rezaee, M Mahmoudi, VM Rotello. "Regulation of Macrophage Recognition Through the Interplay of Nanoparticle Surface Functionality and Protein Corona" ***ACS Nano***, 2016, *10*, 4421-4430.
22. S Rana, SG Elci, **R Mout**, AK Singla, M Yazdani, M Bender, A Bajaj, K Saha, UHF Bunz, FR Jirik, VM Rotello. "Ratiometric Array of Conjugated Polymers-Fluorescent Protein Provides a Robust Mammalian Cell Sensor" ***J. Am. Chem. Soc.***, 2016, *138*, 4522-4529.
23. S Rana, ND Le*, **R Mout***, K Saha, GY Tonga, RE Bain, OR Miranda, CM Rotello, VM Rotello. "A Multichannel Nanosensor for Instantaneous Readout of Cancer Drug Mechanisms" ***Nature Nanotechnol.***, 2015, *10*, 65-69. (*equal contribution)
24. GY Tonga, Y Jeong, B Duncan, T Mizuhara, **R Mout**, R Das, ST Kim, YC Yeh, B Yan, S Hou, VM Rotello. "Supramolecular Regulation of Bioorthogonal Catalysis in Cells using Nanoparticle-Embedded Transition Metal Catalysts" ***Nature Chem***., 2015, *7*, 597-603.
25. S Rana, NDB Le, **R Mout**, B Duncan, SG Elci, K Saha, VM Rotello. "A Multichannel Biosensor for Rapid Determination of Cell Surface Glycomic Signatures" ***ACS Cent. Sci.***, 2015, *1*, 191-197.
26. CS Kim, **R Mout**, Y Zhao, YC Yeh, R Tang, Y Jeong, B Duncan, JA Hardy, VM Rotello. "Co-Delivery of Protein and Small Molecule Therapeutics using Nanoparticle-Stabilized Nanocapsules" ***Bioconjug. Chem***., 2015, *26*, 950-954.

27. E Jeoung, YC Yeh, T Nelson, T Kushida, LS Wang, **R Mout**, X Li, K Saha, A Gupta, GY Tonga, JJ Lannutti, VM Rotello. "Fabrication of Functional Nanofibers through Post-Nanoparticle Functionalization" ***Macromol. Rapid Commun***., 2015, *36*, 678-683.
28. Z Ekmekci, K Saha, DF Moyano, GY Tonga, H Wang, **R Mout**, VM Rotello. "Probing the Protein–Nanoparticle Interface: The Role of Aromatic Substitution Pattern on Affinity" ***Supramol. Chem***., 2015, *27*, 123-126.
29. Y Jiang, R Tang, B Duncan, Z Jiang, B Yan, **R Mout**, VM Rotello. "Direct Cytosolic Delivery of siRNA using Nanoparticle-Stabilized Nanocapsules" ***Angew. Chem. Int. Ed. Engl.***, 2015, *54*, 506-510.
30. X Li, YC Yeh, K Giri, **R Mout**, RF Landis, YS Prakash, VM Rotello. "Control of Nanoparticle Penetration into Biofilms through Surface Design" ***Chem. Commun.***, 2015, *51*, 282-285.
31. X Li, H Kong, **R Mout**, K Saha, DF Moyano, SM Robinson, S Rana, X Zhang, MA Riley, VM Rotello. "Rapid Identification of Bacterial Biofilms and Biofilm Wound Models using a Multichannel Nanosensor" ***ACS Nano***, 2014, *8*, 12014-12019.
32. YC Yeh, R Tang, **R Mout**, Y Jeong, VM Rotello "Fabrication of Multiresponsive Bioactive Nanocapsules through Orthogonal Self-Assembly" ***Angew. Chem. Int. Ed. Engl.,*** 2014, *53*, 5137-5141.
33. YC Yeh, S Rana, **R Mout**, B Yan, FS Alfonso, VM Rotello. "Supramolecular Tailoring of Protein–Nanoparticle Interactions using Cucurbituril Mediators" ***Chem Commun***., 2014, *50*, 5565-5568.
34. R Tang, CS Kim, DJ Solfiell, S Rana, **R Mout**, EM Velázquez-Delgado, A Chompoosor, Y Jeong, B Yan, ZJ Zhu, CK Kim, JA Hardy, VM Rotello. "Direct Delivery of Functional Proteins and Enzymes to the Cytosol using Nanoparticle-Stabilized Nanocapsules" ***ACS Nano***, 2013, *7*, 6667-6673.
35. V Nandwana, **R Mout**, YC Yeh, S Dickert, MT Tuominen, VM Rotello. "Patterning of Protein/Quantum dot Hybrid Bionanostructures" ***J. Inorg. Organomet. Polym. Mater***., 2013, *23*, 227-232.
36. S Rana, AK Singla, A Bajaj, SG Elci, OR Miranda, **R Mout**, B Yan, FR Jirik, VM Rotello. "Array-Based Sensing of Metastatic Cells and Tissues using Nanoparticle–Fluorescent Protein Conjugates" ***ACS Nano***, 2012, *6*, 8233-8240.
37. S Rana, A Bajaj, **R Mout**, VM Rotello. "Monolayer Coated Gold Nanoparticles for Delivery Applications" ***Adv. Drug. Deliv. Rev***., 2012, *64*, 200-216.
38. HK Vora, FR Shaik, I Pal-Bhowmick, **R Mout**, GK Jarori. "Effect of Deletion of a Plant Like Pentapeptide Insert on Kinetic, Structural and Immunological Properties of Enolase from *Plasmodium falciparum*" ***Arch. Biochem. Biophys.***, 2009, *485*, 128-138.

PATENTS

1. **R Mout**, and GQ Daley. "Compositions and methods for T-cell development and stimulation using designed expandable notch agonists" Provisional patent application filed, Application Number. 63/800,138
2. **R Mout**, G Daley, *et al*., "Methods and compositions for T-cell differentiation" Application Number. 63/413,377
3. **R Mout**, D Baker, *et al*., "De novo design of multi-component protein hydrogel with programmable viscoelasticity" US Patent App. 63/353,391
4. Y Hsia, **R Mout**, D Baker, *et al*., "WORMS Scaffolds: Multi-scale protein complexes" US Patent App. 17/564,467
5. VM Rotello, **R Mout**. "Nanoparticle-Protein Complex for Intracellular Protein Delivery" US application (USPTO)- US20180022831A1. **Patent status: granted, 09/2020**

INVITED TALKS AND CONFERENCES

Invited Talks:

- "Design of a Soluble Multivalent Notch Agonist." Stem Cell Day, Boston Children's Hospital, October 29, 2024.
- "Design of a Soluble Multivalent Notch Agonist for T cell Differentiation." Gordon Research Conference (GRC) on Notch signaling, Bates College, USA, July 14-19, 2024.
- "Designer Protein for Stem Cell Engineering." Boston Protein Design and Modelling Club (BPDMC), Harvard Medical School, USA, May 8, 2004.
- "New Age Medicine: From Gene Editing and Protein Design to Stem Cell Engineering." Indian Institute of Technology Guwahati (IIT-G), India, January 5, 2024.
- "New Age Medicine." Assam downtown University (AdtU), India, January 6, 2024.
- "Engineering Blood Stem and T-cells using Gene Editing and Protein Design." India-International Science Forum (Virtual talk), December 20, 2023.
- "From Designing Brand New Protein Molecules to Engineering Cells." Research and Industrial Conclave - Integration' 23, Indian Institute of Technology Guwahati (IIT-G), India, May 15, 2023.

- "Building Brand New Protein Machines." International Conference in Emerging Technologies in Chemistry (ICETC), Don Bosco University, Guwahati, India, March 16, 2023.
- "From Building Protein Molecules to Engineering Stem Cell." National Nanomedicine Seminar, Northeastern University, Boston, USA, February 14, 2023.
- "Ligand Engineering Reveals Novel Mechanisms of Notch Signaling." 21st Annual Pediatric Hematology/Oncology Retreat, Dana-Farber Cancer Institute and Boston Children's Hospital, MIT Endicott House, USA, October 6, 2022.
- "Bottom-up Engineering: Making Brand New Protein Machines from Scratch." SKC Science and Technology Lecture (Virtual), March 5, 2022.
- "Making self-assembled superstructures for CRISPR-Cas9 mediated genome editing." University of Massachusetts Amherst Research fest, September 1, 2015.

Poster Presentations:

- "Design of a Soluble Multivalent Notch Agonist." Biomedical Society Conference (BMES), Baltimore, USA, October 23-26, 2024.
- "Notch Activation with Engineered Soluble Ligands for the Generation of Hematopoietic Stem and Progenitor Cells and T-cells from Human iPSC." International Society for Stem Cell Research (ISSCR), Boston, USA, June 14-17, 2023.
- "Ligand Engineering for Soluble Notch Activation for the Generation of Human Cord Blood Derived T-Cells." NHLBI Progenitor Cell Translational Consortium (PCTC) Meeting, NIH, USA, March 28-29, 2023.
- "Ligand Engineering for Notch Activation for the Generation of Hematopoietic Stem and Progenitor Cells and T-cells from Human iPSCs." Stem Cell Day, Boston Children's Hospital, Boston, May 9, 2023.
- "Environmentally responsive 'molecular zipper' between nanoparticles and proteins." University of Massachusetts Amherst Research fest, August 25, 2014.

TEACHING

- Modern medicine, Spring 2022: Taught a course (6 classes) to more than 210 registered participants from across the globe. The topics included are genetic engineering, protein engineering, and stem and immune cell engineering, two classes each. Some of these lectures are now available in YouTube.
- Molecular Machines: structure-function relationship of proteins, ScienSpur and Mittal Family Institute at Harvard, 2021-2024 (two classes each semester)
- CRISPR-Cas9 based genome editing, Indian Institute of Technology, Guwahati, India, 2021 (two classes)
- Biomaterials seminar, BioE/ChemE 511, University of Washington, winter 2021 [Instructor: Cole DeForest]
- CHEM 110 & CHEM 111 labs, University of Massachusetts, 2010-2012
- Mass spectrometry and proteomics, Tata Institute of Fundamental Research, 2008
- Part-time high school teacher, Assam, 2001-2003

MENTORING

- Mentored the following undergraduate and graduate students:
  -Tristan Tay at UMASS as an undergraduate student (Currently a Ph.D. student at Harvard University)
  -Kanae Sasaki at UMASS as an undergraduate student (Currently a Ph.D. student at Harvard University)
  -Trinava Roy at UMASS as an undergraduate student (Currently a Resident Physician at Jefferson Health New Jersey)
  -James McMillan at UMASS as an undergraduate student
  -Erin Phillips at UMASS as an undergraduate student
  -Prashanth Rau at UMASS as an undergraduate student (Currently a Physician)
  -Anastasiia Klimova at UMASS as a rotating graduate student (Currently a scientist at Ultragenyx Pharma. Inc)
  -Natasha I Edman at University of Washington, an MD/PhD student (Currently Resident Physician at Northwestern University)
  -Martin Kononov at Boston Children's Hospital as a research assistant

STEM OUTREACH

- Sunday Science Activism, an outreach program I run every Sunday for one and a half hours to interact with college-university students from around the world. Meetings happen through zoom calls.
- Founder, Uplift libraries (https://upliftlibraries.com/)

- IPD Science booth at Farmer's market, University district, Seattle, 2017-2020
- Panelist, STEM mentors cluster program at Bellevue College, November 6th, 2019
- IPD AAAS mentoring program at the University of Washington, February 13th, 2020
- Panelist, STEM student association, Bellevue College, February 27th, 2020
- Panelist, Bellevue College STEM Mentor Clusters, November 18th, 2020
- RealNetwork mentor scholar: mentoring students one-on-one from diverse backgrounds and from colleges around the Seattle area

AWARDS & DISTINCTIONS
- Achiever's Award in Science and Innovation, Sadin-Pratidin group, India, 2023
- T32 NIH training grant, 2021-2024
- Washington Research Foundation Innovation Fellowship, 2017-2020
- Travel Grant Award by University of Massachusetts for Genome engineering workshop, Massachusetts Institute of Technology, 2016
- Marvin D. Rausch Scholarship award for best Research Talk, 25th Annual Research Symposium, University of Massachusetts, 2015
- Marvin D. Rausch Scholarship award for best Poster, 24th Annual Research Symposium, University of Massachusetts, 2014
- Discovery Park Research Internship, Purdue University, Indiana, USA, 2008
- Junior Research Fellowship (JRF), Council for Scientific and Industrial Research (CSIR), Government of India, 2006
- Best graduate student in Science, Tinsukia College, India, 2003
- Ranked 1st class 2nd in Chemistry honors, Dibrugarh University, India, 2003

BOOKS, WRITINGS & EDITING
- *Moro Eta Sapon Ase*, memoir, in Assamese, First published: 2017
  [This book is a best-seller in Assamese, selling over 55,000 copies till August 2025; also, adapted into the curriculum in Schools/Colleges/Universities across Assam, India]
- *Dhuxorotat Xonghoto Shrawan*, a collection of short stories; First published: 2015
- Editorial board member, *Frontiers in Energy Research*, the U.S. Department of Energy's newsletter (2019-2020)
- Writer at *Frontiers in Energy Research*, (2019-2020)

MEMBERSHIP
- American Chemical Society (ACS)
- The Protein Society
- The International Society for Stem Cell Research (ISSCR)
- International Society for Experimental Hematology (ISEH)
- Biomedical Engineering Society (BMES)

PROFESSIONAL CONTRIBUTIONS
- Set up, and directed a Mass Spectrometry based proteomics facility at the Department of Biological Sciences, Tata Institute of Fundamental Research (TIFR), Mumbai, India