

Rachit Agarwal

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Employment

- Assistant Professor June 2017 – present
Centre for Biosystems Science and Engineering, Indian Institute of Science, Bangalore
- Post-doctoral Fellow August 2013 – May 2017
Andres J. Garcia, Georgia Institute of Technology, Atlanta, Georgia, USA

Education

- Ph.D. Biomedical Engineering May 2013
Krishnendu Roy, University of Texas at Austin, Texas, USA
Dissertation title: Effect of shape on cell internalization of polymeric hydrogel nanoparticles
- Doctoral portfolio program in Nanoscience and Nanotechnology May 2013
University of Texas at Austin, Texas, USA
- B.Tech and M.Tech (combined degree) - Biotechnology and Biochemical Engineering June 2009
Indian Institute of Technology, Kharagpur, India
Thesis Title: Crystallization and Enzyme Assay of GAPDH from TASAR Silk Worm

Publications (reverse chronological order)

- Dravid A.A.; Dhanabalan K.M.; Agarwal S.; **Agarwal R.**, Resolvin D1-loaded nanoliposomes promote M2 macrophage polarization and are effective in treatment of Osteoarthritis. Submitted
- Sharma P.R.; Dravid A.A.; Kalapala Y.C.; Gupta V.K.; Jeyasankar S.; Goswami A.; **Agarwal R.**, Cationic inhalable particles for enhanced drug delivery to Mycobacterium tuberculosis infected macrophages. Submitted
- Dhanabalan K.M.; Dravid A.A.; Agarwal S.; Sharath R.K.; Padmanabhan A.K., **Agarwal R.**, Rapamycin microparticles induce autophagy, prevent senescence and are effective in treatment of Osteoarthritis. [BioRxiv](https://doi.org/10.1101/2021.07.20.453073). <https://doi.org/10.1101/2021.07.20.453073>
- Kalapala Y.C.; Sharma P.R.; **Agarwal R.**, Antimycobacterial potential of Mycobacteriophage under disease-mimicking conditions. *Frontiers in Microbiology*. 11 (2020) 583661.
- Dhanabalan K.M.; Gupta V.K.; **Agarwal R.**, Rapamycin-PLGA microspheres induce autophagy and prevent senescence in chondrocytes and exhibit prolonged retention in mice joints. *Biomaterials Science*. 8 (2020) 4308 – 4321.
- Quiros M.; Feier D.; Birkl D.; **Agarwal R.**; Zhou D.W.; Garcia A.J.; Parkos C.A.; Nusrat A., Resolvin E1 is a pro-repair molecule that promotes intestinal epithelial wound healing. *Proceedings of the National Academy of Sciences USA*. 117 (2020) 9477-9482.
- **Agarwal R.**; Johnson C.T.; Imhoff B.R.; Donlan R.M.; McCarty N.A.; García A.J., Inhaled bacteriophage-polymeric particles ameliorate lung cystic fibrosis infections. *Nature Biomedical Engineering*. 2, (2018) 841-849.
- Johnson C.T.; Wroe J.A.; **Agarwal R.**; Martin K.E.; Guldborg R.E.; Donlan R.M.; Westblade L.F.; García A.J., Hydrogel delivery of lysostaphin eliminates orthopaedic implant infection by Staphylococcus aureus and supports fracture healing. *Proceedings of the National Academy of Sciences USA*. 115 (2018) E4960-E4969.
- Alas G.R*.; **Agarwal R***.; Collard D.M.; García A.J., Peptide-functionalized poly[oligo(ethylene glycol) methacrylate] brushes on dopamine-coated stainless steel for controlled cell adhesion. *Acta Biomaterialia*. 59 (2017) 108-116. (*= equal contribution).

- Journey P.; **Agarwal R.**; Singh V.; Choi D.; Roy K.; Sreenivasan S.V.; Shi L., Unique size and shape-dependent uptake behaviors of non-Spherical nanoparticles by endothelial cells due to a shearing flow. [Journal of Controlled Release](#). 245 (2016) 170-176.
- **Agarwal R.*.**; Volkmer T.M*.; Wang P.; Lee A.; Wang Q.; García A.J., Synthesis of self-assembled IL-1Ra-presenting nanoparticles for the treatment of osteoarthritis. [Journal of Biomedical Materials Research Part A](#). 104 (2015) 595-599 (*= equal contribution).
- Journey P.; **Agarwal R.**; Roy K.; Sreenivasan S.V.; Shi L., Size-Dependent Nanoparticle Uptake by Endothelial Cells in a Capillary Flow System. [Journal of Nanotechnology in Engineering and Medicine](#). 6 (2015) 011007-011013.
- **Agarwal R.**; Journey P.; Raythatha M.; Singh V.; Sreenivasan S.V.; Shi L.; Roy K., Effect of Shape, Size, and Aspect Ratio on Nanoparticle Penetration and Distribution inside Solid Tissues Using 3D Spheroid Models. [Advanced Healthcare Materials](#). 4 (2015) 2269-2280.
- **Agarwal R.**; González-García C.; Torstrick B.; Guldberg R.E.; Salmeron-Sanchez M.; García A.J., Simple coating with fibronectin fragments enhances stainless steel screw osseointegration in healthy and osteoporotic rats. [Biomaterials](#). 63 (2015) 137-145.
- Singh V.; **Agarwal R.**; Marshall K.; Journey P.; Roy K.; Shi L.; Sreenivasan S.V., Scalable Fabrication of Ultra-Soft Shape Specific Nanocarriers for Diagnostics and Drug Delivery. [Journal of Micro and Nanomanufacturing](#). 3 (2015) 011002-011010.
- Singh A.; **Agarwal R.**; Diaz C.; Willett N.J.; Wang P.; Lee A.; Wang Q.; Guldberg R.E.; García A.J., Nanoengineered Particles for Enhanced Intra-Articular Retention and Delivery of Proteins. [Advanced Healthcare Materials](#). 3 (2014) 1562-1567.
- **Agarwal R.**; Singh V.; Journey P.; Shi L.; Sreenivasan S.V.; Roy K., Mammalian cells preferentially internalize hydrogel nanodiscs over nanorods and use shape-specific uptake mechanisms. [Proceedings of the National Academy of Sciences USA](#). 110 (2013) 17247-17252.
- Journey P.; **Agarwal R.**; Singh V.; Roy K.; Sreenivasan S.V.; Shi L., Size-Dependent Nanoparticle Margination and Adhesion Propensity in a Microchannel. [Journal of Nanotechnology in Engineering and Medicine](#). 4 (2013) 031002-031009.
- **Agarwal R.**; Singh V.; Journey P.; Shi L.; Sreenivasan S.V.; Roy K., Scalable Imprinting of Shape-Specific Polymeric Nanocarriers Using a Release Layer of Switchable Water Solubility. [ACS Nano](#). 6 (2012) 2524-2531.
- Mukherjee S.; Maity S.; Roy S.; Ghorai S.; Chakrabarti M.; **Agarwal R.**; Dutta D.; Ghosh A.K.; Das A.K., Cloning, overexpression, purification, crystallization and preliminary X-ray diffraction analysis of glyceraldehyde-3-phosphate dehydrogenase from *Antheraea mylitta*. [Acta Crystallographica Section F](#). 65 (2009), 937-940.

Book Chapters and Review Articles

- Iyer S.; Yadav R.; Agarwal S.; Tripathi S.; **Agarwal R.**, Bioengineering Strategies for Developing Vaccines Against Respiratory Viral Diseases. Under revision at *Clinical Microbiology Reviews*
- Goswami A.; Sharma P.R.; **Agarwal R.**, Combatting intracellular pathogens using bacteriophage delivery. [Critical Reviews in Microbiology](#), (2021) 1-18.
- **Agarwal R.**; García A.J., Surface Modification of Biomaterials. *Principles of Regenerative Medicine, 3rd edition, Elsevier Academic Press*, Book Chapter, [Chapter 37](#), (2018) 651-660.
- **Agarwal R.**, Book Review: Annual Review of Biomedical Engineering, 2017. [Current Science](#), 114 (2018) 2194-2195.
- **Agarwal R.**; García A.J., Biomaterial strategies for engineering implants for enhanced osseointegration and bone repair. [Advanced Drug Delivery Reviews](#). 94 (2015) 53-62.

- **Agarwal R.;** Roy K., Intracellular delivery of polymeric nanocarriers: a matter of size, shape, charge, elasticity and surface composition. *Therapeutic Delivery*. 4 (2013) 705-723.

Patents and Design

- **Agarwal R** C/O. Indian Institute of Technology Kharagpur. A small-scale plant bioreactor. Indian Patent Application. Publication number: 13/2010. Application Number: 1634/KOL/2008. Date of Application: 23/9/2008. Filed and pending approval.
- **Agarwal R.** “Plant Bioreactor” Indian Design Number: 218742.

Awards and Honors

- Intermediate Fellowship award from the Wellcome Trust/DBT India Alliance, July 2020
- Har Govind Khorana-Innovative Young Biotechnologist Award, Department of Biotechnology, November 2019
- Lakshmi Narayanan Young Investigator Award, Indian Institute of Science, October 2019
- Early Career Research Award, Science and Engineering Research Board (SERB), 2018
- Ramanujan Fellowship, Department of Science and Technology (DST), 2017
- Outstanding Reviewer status for the journal Biomaterials, June 2017
- Travel Award: National Science Foundation (NSF) and Regenerative Engineering and Medicine Center (REM), 2015, 2016 and 2017
- STAR Award, Society of Biomaterials, Boston, MA, 2013
- Travel Award: Center for Nano and Molecular Science, University of Texas at Austin, 2013
- Technopreneur Promotion Programme award, Ministry of Science and Technology, 2009

Funding as Principal Investigator

- Engineering Carriers for Treatment of Inflammatory Diseases and Infections: **Start-up grant**, Indian Institute of Science, India (August 2017 – October 2019). **Total Amount: ₹120 lakhs**
- Delivery of bacteriophages for treatment of antibiotic resistant TB infections: **Ramanujan Fellowship**, Department of Science and Technology, India (October 2017 – December 2020). **Total Amount: ₹38 lakhs**
- Delivery of Resolvin carrier for treatment of Osteoarthritis: **Early Career Research Award**, Science and Engineering Research Board, India (Nov 2018 – Oct 2021). **Total Amount: ₹47.14 lakhs**
- Bacterial outer membrane vesicles coated nanoparticles for development of tuberculosis vaccine: **Sentinels Award Series I**, jointly supported by DBT-BMGF-BIRAC-Wellcome (June 2019-Feb 2021). **Total Amount: ₹50 lakhs**
- Innovation Derby: Phage Reduction of TB-Related Deaths: **Bill & Melinda Gates Foundation** (April 2019-March 2022). **Total Amount: ₹172.21 lakhs**
- Rapamycin carrier based sustained delivery for treatment of Osteoarthritis: **Har Govind Khorana-Innovative Young Biotechnologist Award**, Department of Biotechnology (March 2020-March 2023). **Total Amount: ₹54.92 lakhs**
- Development of 3-dimensional necrotic tuberculosis granuloma mimic for studying lineage-specific drug efficacy: **Intermediate Fellowship, Wellcome Trust/DBT India Alliance** (January 2021 – December 2025). **Total Amount: ₹356.37 lakhs**

Key Conference Presentations and Invited Lectures

- Invited Lecture: Rapamycin-loaded microparticles for osteoarthritis treatment, IEEE Indian Institute of Technology, Kharagpur Section EMBS Student Branch Chapter (SBC), 21st April 2021

- Invited Lecture: Engineering Biomaterial Carriers for Treatment of Inflammatory Diseases and Infection, C-DNA (CeNSE DBT Nanobiotechnology Alliance) program, Indian Institute of Science, 11-13th Jan, 2021
- Invited Lecture: Biomaterials based drug delivery, AICTE Short Term Course – Advances in Biomaterials and Tissue Engineering, Indian Institute of Technology, Madras, 25-30th Jan 2021
- Invited Lecture: "Technological Developments in Bioprocessing", 23rd September 2020 in Biochemical Engineering Department, B.T. Kumaon Institute of Technology.
- Development of 3-dimensional necrotic tuberculosis granuloma mimic, 11th World Biomaterial Congress, Online, 11-15th December 2020.
- Biomaterial-based dry powder delivery of bacteriophage for treatment of drug-resistant Tuberculosis, Mycobacterial heterogeneity and host tissue tropism, EMBO Symposium, New Delhi, India, 11-15th February 2020.
- Biomaterial-based bacteriophage therapy for drug resistant Tuberculosis, Challenges of TB: UK-India Newton-Bhabha fund RSC Researcher Links Workshop, IISER Pune, 16-19th December 2019. Selected for travel funding.
- Dry powder inhalable bacteriophage-polymeric particles reduce lung cystic fibrosis bacterial infections, Society for Biomaterials, April 2017, Minneapolis, MN, USA.
- Engineering Carriers for Treatment of Inflammatory Diseases and Infections, Ohio State University, January 2017, Columbus, Ohio, USA.
- Bone-geneering, BlueSky Retreat, July 2015, Barnsley Gardens Resort, Adairsville, GA, USA.
- Inhalable Dry Powder Microparticles for Delivery of Bacteriophages to Treat Cystic Fibrosis Associated Bacterial Lung Infections, Society for Biomaterials, April 2015, Charlotte, NC, USA.
- Effect of Recombinant Fibronectin Fragment Coating on Osseointegration of Stainless-Steel Screws in Healthy and Osteoporotic Rats, Society for Biomaterials, April 2015, Charlotte, SC, USA.
- Shape Matters: Effect of Polymeric Nanocarriers Shape on Epithelial and Endothelial Cell Lines, Society of Controlled Release, July 2013, Honolulu, HI, USA.
- Geometry Matters: Cellular Uptake of Nanoscale Drug Carriers is Uniquely Dependent on Particle Size and Shape, Society for Biomaterials April 2013, Boston, MA, USA
- Nanoimprint Lithography to Study Effect of Shape of Nanocarriers for Drug Delivery, Biomedical Engineering Society, October 2011, Hartford, CT, USA.

Professional Service

Early career editorial board member for Journal of Biomedical Materials Research Part A (JBMR-A) since July 2021.

Reviewer for following journals:

Acta Biomaterialia, Advanced Drug Delivery Reviews, Biomaterials, Biomedical Materials, Colloids and Surfaces B: Biointerfaces, International Journal of Pharmaceutics, Journal of Biomedical Materials Research Part A, Journal of Drug Delivery Science and Technology, Journal of Materials Chemistry B, RSC Advances, Science Advances, Scientific Reports

Lifetime member of Indian Society of Nanomedicine

Teaching

- Taught the course, "Drug Delivery: Principles and Engineering" for NPTEL platform in July-October 2019 and 2020.
- Taught the course, "Drug Delivery: Principles and Engineering", Indian Institute of Science, Bangalore, Fall 2018, 2019 and 2020.

- Coordinator for the course, “Bioengineering Practicum – I and II”, Indian Institute of Science, Bangalore, Fall 2018, 2019 and Spring 2019, 2020, 2021

Mentoring

Six ongoing PhD. Students:

Pallavi Raj Sharma (Delivery of bacteriophages for treatment of antibiotic resistant TB infections)
Ameya Atul Dravid (Delivery of Resolvin carrier for treatment of Osteoarthritis)
Kaamini MD (Rapamycin carrier based sustained delivery for treatment of Osteoarthritis)
Vishal Gupta (Development of 3-dimensional necrotic granuloma model for understanding Tuberculosis)
Rajesh Yadav (Co-advised with Dr. Shashank Tripathi, MCB, IISc on Flu vaccines)
Neeraja PS (Co-advised with Dr. Kartik Sunagar, CES, IISc on development of anti-snake venoms)

Others:

One clinical intern (Chriset Jayaraj)
Four postdocs (Dr Priyanka Padwal, Dr Edna George, Dr Avijit Goswami and Dr Anil Chandra)
Five project assistants (Iti Gauttam, Yeswanth Kalapala, Shalini C, Smriti Agarwal, and Sharumathi J)
Three undergraduate final year projects (Lakshay Sethi, Abhirami PS and Soumyadeep Naskar)
One summer intern (Saptashwa Dutta)

Mentoring outside IISc

Doctoral Committee Member: Ms. Jyothilekshmi I., Centre for Bio Separation Technology (CBST) at Vellore Institute of Technology, Vellore
External expert on Doctoral Committee: Dr Amulya T.M., Department of ENT, JSS Medical College, Mysore

Google Scholar Profile: <https://scholar.google.com/citations?user=70JHIQMAAAJ&hl=en>