BIOGRAPHICAL SKETCH

NAME: Ashutosh Agarwal

eRA COMMONS USER NAME: Ashutosh_Agarwal

POSITION TITLE: Associate Professor of Biomedical Engineering, University of Miami
Associate Director, DJT Macdonald Foundation Biomedical Nanotechnology Institute at the University of Miami

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	Completion Date	FIELD OF STUDY
Indian Institute of Technology Roorkee, India	B. Tech.	05/2005	Metallurgical & Materials Engg.
University of Florida, Gainesville, FL	Ph.D.	12/2009	Materials Science & Engineering
Columbia University, New York, NY	Postdoctoral	11/2010	Biomedical Engineering
Harvard University, Cambridge, MA	Postdoctoral	12/2013	Engg and Applied Science

A. Personal Statement

I am an Associate Professor of Department of Biomedical Engineering, and Director of Engineering & Applied Physics for the Desai Sethi Urology Institute at the University of Miami. The research mission of my Physiomimetic Microsystems Laboratory is on building microscale functional mimics of different organ systems for applications such as drug testing, stem cell maturation, disease modeling and creating better transplants. These in vitro systems replicate the key functional unit of an organ within physiologically relevant microenvironments, are amenable to microfluidic integration, and provide quantifiable structural, functional and genomic data over time.

We are also dedicated to removing the translational barriers for widespread adoption of these platforms for drug screening and development. Based on our key patents, and a commercialization grant from the Wallace H. Coulter Foundation for Translational Research, we have spun out two start-up companies from the lab, Bio-Vitro Inc. (fluidic platforms to enable PDMS-free organ on chip applications), and Circulogix Inc. (rapid isolation and enumeration of circulating tumor cells in an antigen-agnostic manner).

I inculcate a culture of open dialogue, ethical research, cordial working relationships, and a strong emphasis on technical speaking and writing. I am currently training 2 Postdoctoral Fellows (both female), 4 PhD students (2 female), and 7 undergraduate students (5 female). I serve as the faculty advisor for UM student chapters of Biomedical Engineering Society (BMES) and National Society of Black Engineering (NSBE). I run a 100k/year paid research internship and tiered mentorship program for UM Black Undergraduate students, and Black High-School students who are in the Miami Dade County foster-care system. The interdisciplinary nature of my laboratory and strong collaborations with a multitude of research labs, especially at medical schools, provides an enriching training environment for my trainees.

I look forward to mentoring my trainees on the highly exciting and collaborative research studies with Dr. Gaston, Dr. Kobetz and Dr. Oehlert outlined in this grant application. Our track record with both collaborative funded projects, and collaborative publications gives us high confidence in executing the proposed studies. For this grant application, we will build upon our published chip designs that allow culture of organoids, spheroids and cellular monolayers within single wells that are individually addressable with controlled fluidic flows, local oxygen environments, and control of cytokine movement from one well to another. Building upon these first generation chips, we will deploy (also already developed and published) modular architecture chips that allow induction of toxicants to lung and liver chips under long term perfusion and culture. Working closely with Gaston lab, we will discuss inadequacies in the current design and/or suggest changes for future design iterations. All chips allow in situ imaging and concomitant collection of secretome, and ensure that device inlet and outlet have leak proof fluidic connections, collect samples for biochemical analyses, and help maintain bubble free sterile conditions.

Peer-reviewed original research that highlight my expertise in organoids on a chip platform, directly applicable to the proposed work:

1. E Drabbe, D Pelaez*, **A Agarwal***: "Retinal organoid chip: engineering a physiomimetic oxygen gradient for optimizing long term culture of human retinal organoids", ***Lab on a Chip***, 25, 1626-1636 (2025) ***HIGHLIGHTED AS COVER***
2. CG Alver, S Alvarez-Cubela, I Altilio, E Hutchison, E Warrner, M Viso, G Vitale, D Oliver, R Pastori*, J Dominguez-Bendala*, **A Agarwal***: "SliceChip: Benchtop Fluidic Platform for Organotypic Culture and Serial Assessment of Human and Rodent Pancreatic Slices", ***Lab on a Chip,*** 24, 1557-1572 (2024) ***HIGHLIGHTED AS COVER***
3. CG Alver, E Drabbe, M Ishahak, **A Agarwal***: "Roadblocks confronting widespread dissemination and deployment of Organs on Chips", ***Nature communications,*** 15 (1), 5118 (2024)
4. S Patel†, M Ishahak†, D Chaimov, A Velraj, D LaShoto, P Buchwald, E Phelps, **A Agarwal***, C Stabler*: "Organoid Microphysiological System Preserves Pancreatic Islet Function within 3D Matrix", ***Science Advances***. 7 (7), eaba5515 (2021) † Equal contribution from first authors from Agarwal and Stabler lab

Ongoing projects:

ARPA-H 1AY1AX000038-01 (THEA Program) Funding Period: 09/25/24 –09/24/30

Human Donor Eye Recovery, Preservation, and Allograft Viability Assessment for Transplantation

Agarwal lab deliverable: We will design, build and deploy compact perfusion machines that provide oxygenated normothermic pressurized perfusion of donor eyes immediately after harvesting till transplantation.

NIDDK UE5 DK 137308R01 (PI: Fornoni*, Agarwal) Funding Period: 09/2023 - 08/2028

Workshops and Coaching to Foster Career Skills in Newly Funded NIDDK Scholars

Goal: HARP UE5 Aims at to develop a network of mentors and scholars, with the expectation that scholars will apply for a career stage-appropriate NIH research project grant after their participation in the program.

FL-DOH MOG24 (PI: Dhar. Role: Co-I) Funding Period: 06/29/24-6/30/26

Cardiolipin Enhancing Mitochondria Acting Nanoengineered Tools for Understanding Role of Oxidative Stress and Inflammation in Barth Syndrome

NIH-NIDDK 1R01DK130846-01 (PI: BENDALA. Role: Co-I) Funding Period: 09/20/21 - 08/31/25

Single-cell longitudinal analysis of regeneration in human pancreatic slices

Goal: High-resolution characterization of a well-known mechanism of pancreatic beta cell regeneration, namely, the activation of progenitor cells in the ductal tree by functional characterization of neogenic β-cells through "slice-on-a-chip" approaches.

NIDDK UG3 DK122638-01 (PI: Agarwal, Brusko, Mathews, Stabler*) 07/01/19 - 06/30/24 (Currently NCE)

Engineering a Human Microphysiological System for the Characterization of Islet-Immune Interactions

Goal: This project proposed an interdisciplinary effort to combine past efforts in islet transplantation and immune interfacing to create an integrated MPS platform to more accurately model the complex cellular interactions in Type 1 diabetes.

NIDDK F31DK132916 Funding Period: 09/01/22 - 07/31/26

PI: Charles Alver (Role: Doctoral Mentor)

Glomerulus on a Chip: A Model to Study Glomerular Hyperfiltration

T35 DK121678 Funding Period: 2020 - 2025
PI: Alessia Fornoni (Role: Mentor)
UM Kidney Innovative & Interdisciplinary Medical Education in Research Activities (UM-KIIMERA)

T32 CA211034 Funding Period: 2021 - 2026
PI: Nipun Merchant (Role: Mentor)
Research Training in Surgical Oncology

T32 GM112601 Funding Period: 2022 - 2027
PI: Sandra Lemmon (Role: Mentor)
Medical Scientist Training Program

University of Miami U-LINK award (PI: Agarwal) Funding Period: 09/13/18 - 09/12/24
Joint Academic Nurtureship for Underrepresented Students (JANUS)

Goal: We are funding 10 Black Undergraduate students for immersive research experiences in labs around campus, who in-turn are mentoring Black high-school students from the Miami Dade County foster-care system to demystify college education and careers in STEM for that underserved and vulnerable population.

Completed projects that I would like to include:
U01 CA2333363 (PI: Agarwal*, Cote) Funding Period: 09/13/18 - 09/12/24
A Comprehensive Liquid Biopsy Platform for Detection and Prognostication in Early Stage Breast Cancer

Goal: We will develop a robust and automated liquid biopsy tool based on evaluation of circulating tumor cells (CTCs) and cancer associated fibroblasts (CAF) for predicting recurrence and response to therapy in patients with early stage (I-III) breast cancer.

B. Positions, Scientific Appointments, and Honors

Positions and Employment

2009 – 2010	Postdoctoral Scientist, Department of Biomedical Engineering, Columbia University, NY
2010 – 2013	Postdoctoral Fellow, Wyss Institute, Harvard University, Cambridge, MA
2014 – 2020	Assistant Professor, Department of Biomedical Engineering, University of Miami
2020 – Present	Associate Professor (with Tenure), Biomedical Engineering, University of Miami
2020 – 2022	Associate Director, DJTM Foundation Biomedical Nanotechnology Institute at UM
2022 – Present	Co-Director, Engineering Cancer Cures™, Sylvester Comprehensive Cancer Center
2022 – Present	Director of Engineering & Applied Physics, Desai Sethi Urology Institute

Professional Activities and Honors

Consortium Chair: NIDDK Helping to Accelerate Research Potential (HARP) **(2025 to Present)**

Fellow: Florida Academies of Science, Engineering and Medicine **(inducted 2023)**

Chair: Consortium on Human Islet Biomimetics, NIDDK **(2022 – 2025)**

Member: Trans Network Committee, Human Islet Research Network, NIH-NIDDK **(2014 to 2025)**

Kavli Fellow, National Academy of Science Frontiers of Science **(2019)**

Eliahu I. Jury Early Career Research Award, College of Engineering, University of Miami **(2018)**

Ambassador Scholar of College of Engineering, University of Miami **(2015, 2016, 2017, 2018)**

Provost Research Award, University of Miami. **(2017)**

Associate Editor: IEEE Transactions on NanoBioscience

Grant Review: Ad hoc reviewer for NIH study sections (2-3/year): Cellular and Molecular Technologies (CMT), and several NIDDK and NCATS Special Emphasis Panels for Microphysical Systems (U01s and SBIRs).

Grant Review: Ad hoc reviewer for NSF Engineering in Biomedical Systems (EMBS) Panel (2019), and GRFP

C. Contributions to Science

1. Organs on Chips: Researchers in academia and industry rely primarily on animal models or overly simplified cell culture systems to study human diseases and/or screen drugs. Animal models provide organism-level information, but fundamental differences between species limit their relevance to humans. Traditional cell culture systems, where cells are cultured on Petri dishes or glass slides, do not recapitulate the microenvironment or architecture of native tissues and thus also lack physiological relevance. To address these shortcomings, I and others have used biomaterials, microfabrication, and tissue engineering techniques to build "Organs on Chips" as new cell culture platforms that mimic the chemical, mechanical, and/or physical microenvironment of human organs and provide essential structural and functional readouts. I previously helped develop Heart on a Chip platforms, from animal and human patient cell sources. These platforms have shown promise for both detection of cardiotoxicity and disease modeling applications. Currently, my lab is developing organ chip systems for the glomerulus and the human islet.

1. SN Patel[#], M Ishahak[#], D Chaimov, A Velraj, D LaShoto, DW Hagan, P Buchwald, EA Phelps, **A Agarwal***, CL Stabler*, Organoid Microphysiological System Preserves Pancreatic Islet Function within 3D Matrix, ***Science Advances,*** 7 (7), eaba5515 (2021) [#]equally shared publication between Agarwal and Stabler labs
2. M Ishahak, J Hill, Q Amin, L Wubker, A Hernandez, A Mitrofanova, A Sloan, A Fornoni*, **A Agarwal***: Modular Microphysiological System for Modeling of Biologic Barrier Function", ***Frontiers in Bioengineering and Biotechnology***, 8, (2020)
3. M Ishahak, L Birman, D Carbonero, J Hill, A Hernandez, S Rawal, **A Agarwal***: "Integrated platform for operating and interrogating organs-on-chips", ***Analytical Methods***, 11(43), 5645-5651 (2019) ***EMERGING INVESTIGATORS SERIES***
4. G Lenguito, D Chaimov, J Weitz, R Rodriguez, S Rawal, A T-Garcia, A Caicedo, C Stabler, P Buchwald, **A Agarwal***: "Reseal-able, Optically accessible, PDMS-free Fluidic Platform for ex vivo Interrogation of Pancreatic Islet", ***Lab on a Chip***, 17, 772-781 (2017)

2. Hydrogels for Engineering Biotic/Abiotic Interface: I have expertise in designing specialized microenvironments that ultimately direct cellular behavior and fate. Cardiac tissues commonly delaminate or lose contractile function within a week on conventional culture substrates. We prolonged the culture lifetime of engineering cardiac tissues to over 4 weeks by the use of mechanically compliant hydrogel surfaces. Specifically, (i) Alginate based hydrogels were engineered which served as soft and inert templates for culturing cardiac tissues. Bioconjugation techniques (based on N-hydroxysuccinimide esters) were used to couple ECM motifs directly to alginate. (ii) Gelatin based hydrogels were used in conjunction with a biocompatible crosslinking chemistry (based on microbial transglutaminase) to match the mechanical properties of myocardium. My specific role in these projects was: conception and fabrication of micromolded alginate and gelatin hydrogels, bioconjugation of ECM motifs to alginate hydrogels, for gelatin hydrogels, and their integration into existing Heart on a Chip platforms. Recently, we adopted a coating of thermoresponsive polymer coating, PIPAAm, to viably release live cancer cells and circulating tumor cells (CTC) that had been captured on slot microfilters. This development has enabled the release of CTC into specialized media and microenvironments that could promote their culture and propagation; a long standing challenge in the field of single CTC research.

1. RR Besser, R Maciel, D Cabonero, A Alassaf, I Claure, E Jones, J Reda, A Bowles, W Bachelor, N Ziebarth, R Rodriquez, A Khan, M Saporta, **A Agarwal***: "Enzymatically Crosslinked Gelatin-Laminin Hydrogels for Applications in Neuromuscular Tissue Engineering", ***Biomaterials Science***, 8,591-606 (2020) ***FRONT COVER***
2. A Bowles, M Ishahak, S Glover, D Correa, **A Agarwal***: "Evaluating Vascularization of Heterotopic Islet Constructs as Cell Transplants for Type I Diabetes Using an In Vitro Platform", ***Integrative Biology***, 11(8), 331–341 (2019) ***FRONT COVER ARTICLE***

3. Z Ao, EM Parasido, S Rawal, AJ Williams, R Schlegel, S Liu, C Albanese, R Cote, **A Agarwal***: "Thermoresponsive release of viable microfiltrated Circulating Tumor Cells (CTCs) for precision medicine applications", ***Lab on a Chip***, 15(22), 4277 (2015)
4. RR Besser, I Claure, R Maciel, A Alassaf, D Carbonero, M Saporta, **A Agarwal***: *In vitro* recapitulation of the dysfunctional neuromuscular junction in Charcot-Marie-Tooth disease, ***Journal of the Peripheral Nervous Society***, 23 (4) (2019)

3. Nanobiotechnology: The form and function of living systems are fundamentally different from those of conventional materials and devices. In a modern reductionist view, the arsenal of molecular building blocks and machines that work in tandem to produce living entities can be combined with the structures and devices synthesized with modern nanotechnologies to enable hybrid platforms – to not only derive their functionality from the biological building parts, but also act as an interrogation platform for the biological functionality. I have employed kinesin motor protein, along with microtubule filaments to assemble a nanoscale transport systems. Our report on the design and operation of a smart dust biosensor was the first major device application using active transport driven by molecular shuttles. The same platform also allowed investigation of biophysical processes such as effect of shuttle velocity on cargo attachment via biotin-streptavidin linkages and the mechanism of protein adsorption on highly non-fouling surfaces.

1. A Alassaf, M Ishahak, A Bowles, **A Agarwal*:** "Microelectrode Array based Functional Testing of Pancreatic Islet Cells", ***Micromachines***, 11(5), 507 (2020)
2. A Alassaf, G Tansik, V Mayo, L Wubker, D Carbonero, **A Agarwal***: "Engineering Anisotropic Cardiac Monolayers on Microelectrode Arrays for Non-invasive Analyses of Electrophysiological Properties", ***Analyst***, 145, 139-149 (2020)
3. **A Agarwal**, P Katira, H Hess*: "Millisecond curing time of a molecular adhesive causes velocity-dependent cargo-loading of molecular shuttles", ***Nano Letters***, 9(3), 1170-1175 (2009)
4. T Fischer, **A Agarwal**, H Hess*: "A smart dust biosensor powered by kinesin motors", ***Nature Nanotechnology***, 4, 162-166 (2009)

4. Translation of scientific products through patents

We have expended considerable efforts in bringing organ-on-chip technology to the marker but aggressively filing for protection of intellectual property and then seeking out translational partner for potential licensing opportunities. Related Patents:

1. **POLYMERIC FIBER-SCAFFOLDED ENGINEERED TISSUES AND USES THEREOF**, US Patent 20,150,253,307
2. **MUSCLE CHIPS AND METHODS OF USE THEREOF**, U.S. Application US20140342394A1, Licensed to Emulate Inc.
3. **MULTIWELL CULTURE DEVICES WITH PERFUSION AND OXYGEN CONTROL**, U.S. Patent Application 62/237,996, Option license to Bio-Vitro Inc., a spinout from Agarwal lab
4. **METHOD AND SYSTEM FOR MICROFILTER-BASED CAPTURE AND RELEASE OF CANCER ASSOCIATED CELLS**, US Patent Application 62/219,808, Option license to Circulogix Inc., a UM spin out

Complete List of Published Work in MyBibliography:
http://www.ncbi.nlm.nih.gov/sites/myncbi/10y5cxdZyUT5w/bibliography/46128424/public/?sort=date&direction=ascending