RESEARCH MILESTONES

INNOVATION IN HEALTHCARE

IN BIOMEDICAL ENGINEERING

UNIVERSITY of HOUSTON
CULLEN COLLEGE of ENGINEERING
Department of Biomedical Engineering

Letter from the Chair

Dear Colleagues,

I hope that this message finds you safe and in good health. Despite the challenges presented by the novel coronavirus, our department has been hard at work in our continued pursuit of excellence in academia and research.

I invite you to read through the following research breakthroughs and newly funded projects. If you would like to learn more about how to support a project or collaborate with our department, do not hesitate to let me know.

Warm Regards,

Metin Akay, Ph.D.
Founding Chair, John S Dunn Endowed Chair Professor
Department of Biomedical Engineering
Cullen College of Engineering
Univeristy of Houston

UH BME **BY THE NUMBERS**

#80
BEST BIOMEDICAL ENGINEERING PROGRAM IN THE U.S.
**Source: US News & World Report*

1
NATIONAL **A**CADEMY OF **E**NGINEERING MEMBER

18 TOTAL BIOMEDICAL ENGINEERING FACULTY

308 UNDERGRADUATE STUDENTS

103 GRADUATE STUDENTS

411 TOTAL STUDENTS IN DEPARTMENT

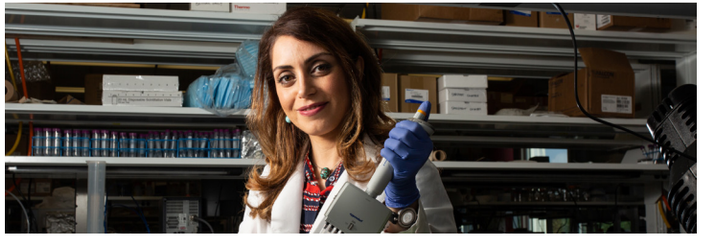
**Student Totals are from Summer 2020 & Fall 2020*

30+ ACTIVE RESEARCH GRANTS

100% PH.D. POST-GRADUDATE JOB PLACEMENT
**Numbers based on Fall 2019 and Spring 2020*

BME FOCUS AREAS:
NEURAL ENGINEERING & REHABILITATION, BIONANOSCIENCE & BIOMEDICAL IMAGING

BIOMEDICAL ENGINEERING

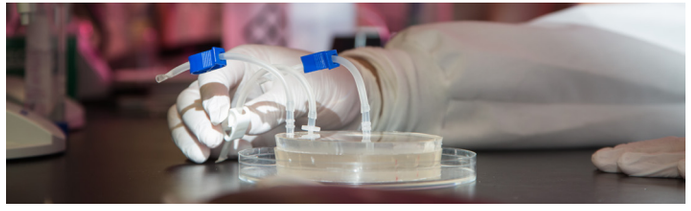


INTERDISCIPLINARY RESEARCH SEEKS DIRECT

AND EFFICIENT DELIVERY OF MACROMOLECULES TO CELLS

Sheereen Majd, assistant professor of biomedical engineering, is co-PI on a $481,000 grant to develop a simple, safe and efficient system to deliver macromolecules to a cell's interior.

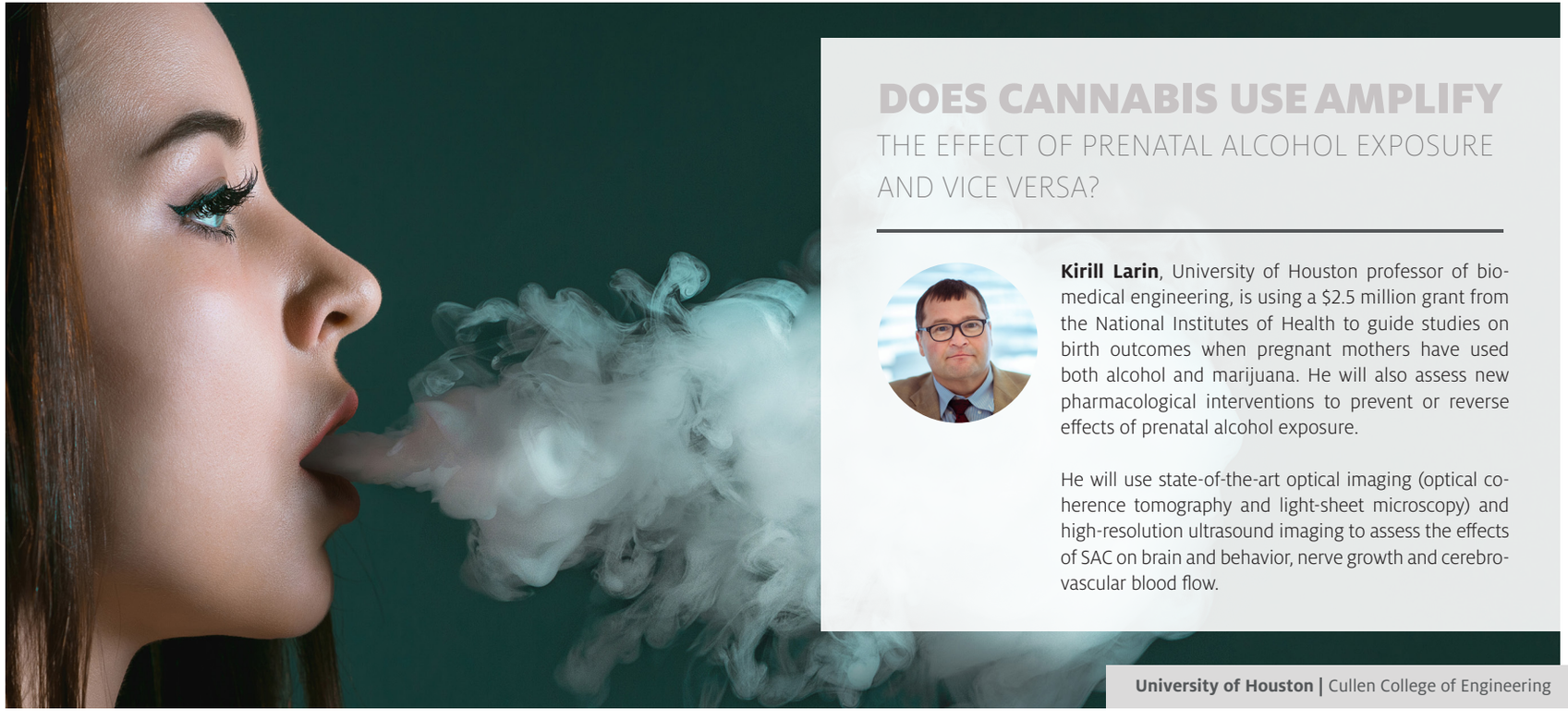
Majd wants to develop a way to deliver macromolecules, like peptides and proteins, to cells because macromolecules have tremendous potential as a therapeutic for diseases. So far, their clinical applications have been limited, as their delivery is more challenging than small molecule therapeutics.



UH RESEARCHER DEVELOPING

NEW DEVICE TO TREAT BABIES WITH BLOOD DISORDERS

Biomedical engineering professor **Sergey Shevkoplyas** is using a $1.6 million grant from the National Heart, Lung, and Blood Institute, to adapt microfluidic technology to enable leukapheresis in babies. Shevkoplyas is developing a new device that looks like a small plastic dish with many tiny channels cut into it. The channels are designed to separate blood cells by size, using a new cell separation approach called controlled incremental filtration (CIF). He and his colleagues are planning to adapt CIF to enable separation of white blood cells from flowing blood with high efficiency, minimal loss of red blood cells and platelets, and at flow rates on par with conventional leukapheresis.



DOES CANNABIS USE AMPLIFY

THE EFFECT OF PRENATAL ALCOHOL EXPOSURE AND VICE VERSA?

Kirill Larin, University of Houston professor of biomedical engineering, is using a $2.5 million grant from the National Institutes of Health to guide studies on birth outcomes when pregnant mothers have used both alcohol and marijuana. He will also assess new pharmacological interventions to prevent or reverse effects of prenatal alcohol exposure.

He will use state-of-the-art optical imaging (optical coherence tomography and light-sheet microscopy) and high-resolution ultrasound imaging to assess the effects of SAC on brain and behavior, nerve growth and cerebrovascular blood flow.

BIOMEDICAL ENGINEERING

FARSIGHTEDNESS TREATMENT RESEARCH RECEVIES

$3 MILLION IN FUNDING FROM THE NATIONAL EYE INSTITUTE

Kirill Larin, professor of biomedical engineering, has received $3 million from the National Eye Institute to create a new technology that will measure the stiffness of the lens in the eye, which is likely associated with presbyopia, or farsightedness, the inevitable and age-related loss of the ability to focus on nearby objects.

The technology will combine Brillouin microscopy, Optical Coherence Tomography (OCT) and Optical Coherence Elastography (OCE) - a new combination to be called BOE. The instrument will be used to generate the first age-dependent data on lens mechanical properties quantified in vivo as well as quantitatively assess therapeutic procedures aimed to restore the ability to focus.

SHEVKOPLYAS'S RESEARCH SEEKS NEW WAY TO **SEPARATE T-CELLS**

With $200,000 in funding from a Cancer Prevention & Research Institute of Texas grant, UH BME professor, **Sergey Shevkoplyas**, and his research team are seeking to revolutionize the first step in a patient's individualized cell-based treatment: the harvesting of T-cells from the patient's blood.

The research team envisions replacing large centrifugation-based machines with a small device, about the size and shape of a small Frisbee, engraved with about a hundred tiny channels specially designed to separate T-cells from the rest of the blood cell by size, in a process called 'controlled incremental filtration' (CIF). The device will be disposable and easy to operate, without a need for any complex equipment. Instead of attaching a patient to a leukapheresis machine and spinning the blood in a centrifuge to separate the T-cells, a technician would simply pass the blood through the device, which would also require smaller amounts of blood from the patient.

The project, titled "Novel High-Throughput Microfluidic Device for Isolating T-cells Directly from Whole Blood to Simplify Manufacturing of Cellular Therapies," is expected to continue through August 2021.

LUPUS RESEARCH ALLIANCE TO SUPPORT UH PROFESSOR WITH ACCELERATOR AWARD

Chandra Mohan, the Hugh Roy and Lillie Cranz Cullen Endowed Professor in Biomedical Engineering at the Cullen College of Engineering, has been given a $300,000 award by the Lupus Research Alliance. Mohan's proposal, "Urinomics as a Guide to the Renal Immune Landscape in SLE," was selected as one of the first recipients for the inaugural LRA-BMS Accelerator Award, a collaborative project with sponsoring partner Bristol Myers Squibb. According to a press release issued by LRA, the award provides a collective total of $3 million to support nine cutting-edge lupus research projects over two years.

RESEARCH FROM AKAY LAB **TOPS AMONG IEEE POPULARITY**

A research paper earlier this year from the **Akay Lab biomedical research team** at the University of Houston's Cullen College of Engineering continues to make an impact, as the Institute of Electrical and Electronics Engineers (IEEE) Engineering in Medicine and Biology Society noted that is the IEEE's second most popular paper in the IEEE Xplore Digital Library as of mid-September.

The library provides access to more than five million documents, including research articles, standards, transactions, eBooks and conference publications. The paper, "Temozolomide in Combination With NF-κB Inhibitor Significantly Disrupts the Glioblastoma Multiforme Spheroid Formation," was posted online by the IEEE in December 2019.

Since that time, it was downloaded more than 10,000 times in July 2020, making it the highest downloaded paper in July alone. The paper was published in the inaugural issue of the IEEE Engineering in Medicine & Biology Society's Open Journal of Engineering in Medicine and Biology as a peer-reviewed, invited paper.

ALCOHOL, NICOTINE CO-EXPOSURE DURING PREGNANCY SIGNIFICANTLY INCREASES HEALTH **RISK IN NEWBORNS**

University of Houston researchers have found that during early pregnancy, the mix of alcohol and nicotine significantly alters the gene regulatory pathways of the developing fetus, which can lead to major deficiencies in brain development. Metin Akay, founding chair and John S. Dunn Endowed Chair Professor of biomedical engineering is reporting the findings, the first study of its kind, in the Nature journal *Scientific Reports*. "Until now, the influence of maternal alcohol and nicotine co-exposure on the brain development of newborns has not been investigated at the multi scale from molecular, to cellular and to systemic levels," said **Yasemin Akay**, instructional associate professor of biomedical engineering and the co-lead investigator on the project. "Our group has focused on the integration of molecular, cellular and systemic data - using a custom-made implantable dopamine probe and artificial intelligence - to better understand the addiction mechanism and develop effective therapeutics," she said. The paper was also co-authored by **Tina Kazemi**, a graduate student supervised by both Metin and Yasemin Akay.

The University of Houston
Cullen College of Engineering

The University of Houston Cullen College of Engineering addresses key challenges in energy, healthcare, infrastructure, and the environment by conducting cutting-edge research and graduating hundreds of worldclass engineers each year. With research expenditures topping $35 million and increasing each year, we continue to followour tradition of excellence in spear-heading research that has a real, direct impact in the Houston region and beyond.

UNIVERSITY of HOUSTON | ENGINEERING

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