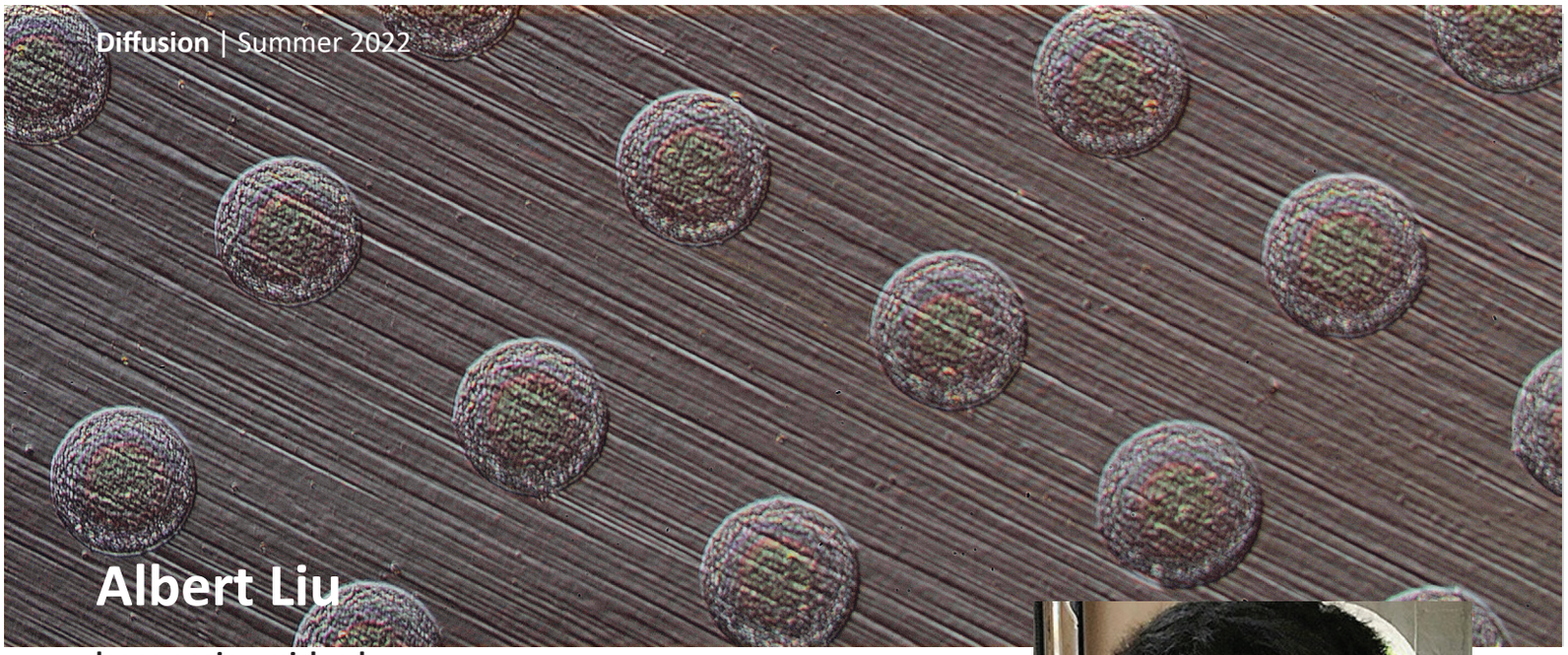
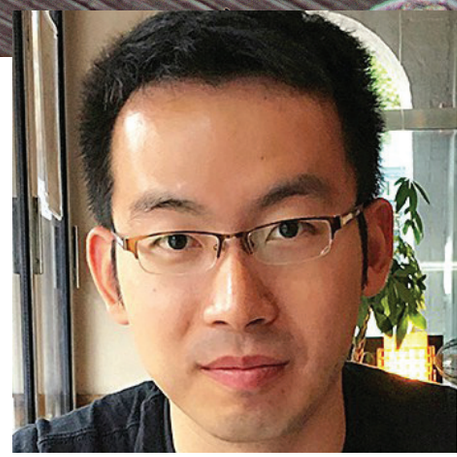
ChEGS Diffusion

News from the Chemical Engineering Graduate Society at Michigan
Summer/Fall 2022



Albert Liu

legos.engin.umich.edu



Colloidal Robotics for Advanced Manufacturing, Distributed Computing, and Human Health

Liu joins the Chemical Engineering department in August 2022 as an assistant professor after completing his Ph.D. at the Massachusetts Institute of Technology (MIT) and post-doctoral work at Stanford University. His lab at the University of Michigan, named "Laboratory of Emergent and Galvanically Orchestrated Systems", or LEGOS for short, will be focused on advancing the field of colloidal robotics for advanced manufacturing, distributed computing, and human health. The lab seeks to address one major question: can we build materials like how nature builds us?

From Chemistry to Chemical Engineering

Ever since high school, Liu has considered chemistry as the central science that bridges the knowledge gap between biology and physics. Fascinated by the capability of the engineering discipline to abstract and rationalize physical phenomena through rigorous mathematical formulae and derivations, he went to the California Institute of Technology (CalTech) to study chemical engineering. While at CalTech, Liu worked on several projects in the fields of homogeneous and heterogeneous catalysis, and developed a strong interest in nanostructured electronic materials, which led him to pursue graduate studies at the Massachusetts Institute of Technology (MIT).

Building Colloidal Robots

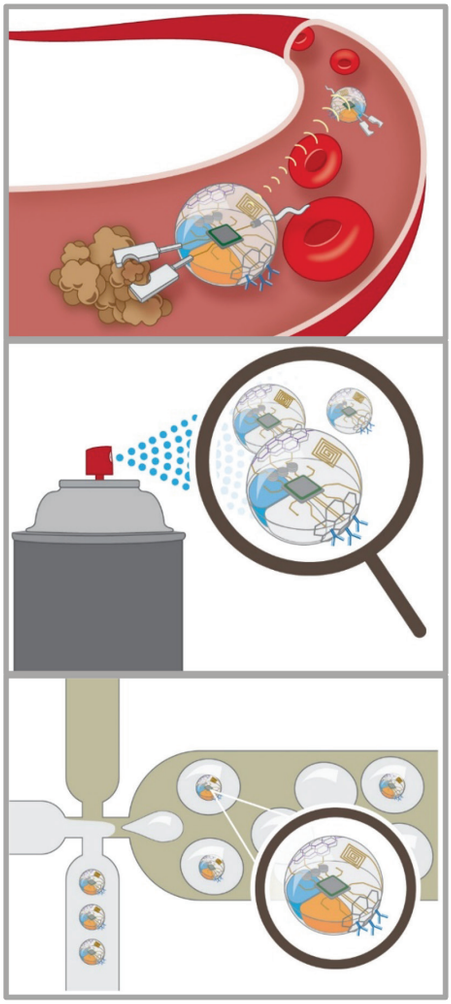
At MIT, Liu worked with Prof. Michael Strano. One of his major projects focused on developing 2D-material-enabled colloidal electronic systems. By grafting nanoelectronic circuits onto colloidal microparticles, these particles could be imbued with an electronic skin. Liu and colleagues developed a scalable "autoperforation" fabrication method and were able to produce near-biological cell size colloidal particles capable of harvesting energy, detecting molecules, and performing logical operations. His research had significant implications in delivering nanoelectronics in previously inaccessible locations, such as inside chemical reactors and the human vascular system.

Towards the end of his graduate work, Liu sought to explore effective communication methods between two or more colloidal electronic "cells", as well as with their biological counterparts. Taken by that idea, Liu conducted post-doctoral work at Stanford Medical School under Prof. Steve Chu to develop a nanostructured, bioelectronic interface capable of using external electric fields to deliver and extract genetic or protein information to and from biological systems like human cancer cells

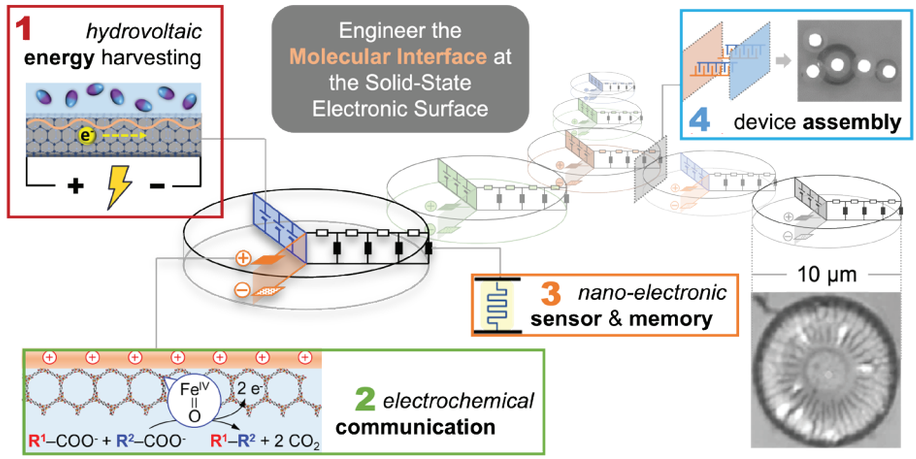
and murine hippocampal neurons.

Building LEGOS

At Michigan, Liu looks to continue his work in colloidal electronics to develop colloidal robotics for advanced manufacturing, distributed computing, and human health. Specifically, his research projects seek to address key challenges in harvesting energy at the cellular scale, inter-particle communication, energy efficient nano-electronic circuitry, and additive manufacturing for cellular-colloidal-electronics systems capable of mimicking complex biological functions. Additional details on available projects can be found on Liu's research website.



Imbuing colloidal microparticles with an electronic skin allows for delivery of nanoelectronics to previously inaccessible locations



The Laboratory of Emergent and Galvanically Orchestrated Systems, or LEGOS for short, will seek to address key challenges in the field of colloidal robotics. Specific projects are available in understanding energy harvesting at a cellular level, inter-particle communications, energy efficient nano-electronic circuitry, and device assembly.

Liu has given a unique name to his lab: "Laboratory of Emergent and Galvanically Orchestrated Systems", or LEGOS for short. Liu says that this name is inspired by his hobby of Legos, stating "the future of adaptive and biomimetic materials lies in their Lego-like modularity. Also, building a new lab from scratch is very similar to building a new Lego set without a full manual or even a complete list of parts. Any research group is fundamentally about its people, so to me the priority is to lay the groundwork that aims to serve its members and support the students to keep building it up into a place that can launch them into exciting future careers in industry or academia." Liu encourages students, especially newer Ph.D. students, to not be daunted by how much there is going around and how much there is to learn, but instead to ask questions with purpose and conviction, saying "being in an environment like the University of Michigan is a once-in-a-lifetime opportunity. Ask experts in their fields how to do things and learn like a sponge."

Liu is excited to begin his career at the University of Michigan, saying "I am very excited about joining the Michigan ChE department because of the fantastic colleagues and students that I have interacted with. The students are high-caliber and exceptionally smart as well as creative. I look forward to meeting all of the new and existing students and I can't wait to start my journey in the department."

" Ask experts in their fields how to do things and learn like a sponge. "

Outside of the laboratory, Liu is an avid cyclist, musician, videographer, and Lego enthusiast. He encourages his students to step away from the lab periodically and unwind. "Science does not come easily", Liu says. "We come up with the best ideas when we are relaxed."

" The future of adaptive and biomimetic materials lies in their Lego-like modularity. Also, building a new lab is very similar to building a new Lego set without a full manual or even a complete list of parts. "