

MIT Chemical Engineering Department

Spring 2021 Seminar Series

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Complex Fluids in Microchannel Flows: from Bleeding to Drug Delivery



Qin Maggie Qi
Postdoctoral Fellow

School of Engineering and Applied Sciences
Wyss Institute for Biological Inspired Engineering
Harvard University

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4:00-5:00PM

Abstract: Flow and transport through microchannels play a remarkable role in regulating human health. My research applies the fundamental principles of fluid mechanics and mass transfer to advance precision medicine with mechanistic and quantitative perspectives, from understanding pathophysiology to fighting COVID-19 and from diagnosis to therapeutics. First, I will discuss how to theoretically predict the timescale of bleeding based on a multiscale kinetic modeling and the microhydrodynamics of cellular suspensions. This theory enables the development of a novel microfluidic diagnostic assay for various bleeding disorders caused by platelet defects, red blood cells, blood flow conditions, COVID etc. Next, I will introduce the development of the first *in vitro* cellular device for testing subcutaneous injection based on the knowledge of multiscale flow and transport. In addition to increasing measurement reliability compared to conventional animal models, this subcutaneous-on-a-chip device also offers new pharmacokinetic insights for drug and formulation development (e.g., lymphatic vs. vascular absorption). Overall, this combination of novel theoretical and *in vitro* methods at the intersection of mechanics and biology opens up broad opportunities in healthcare innovations.