MITMECHE

Colloquium

Mechanical Engineering Lecture in Energy Science and Engineering

Microfluidic Genetic Transformation for the Next Generation of Synthetic Biology

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One major limitation of synthetic biology is the inability to incorporate genetic material into many bacteria due to the challenge of permeating the cell envelope while maintaining high cell viability. There are millions of species of bacterial species on the planet, yet we can only genetically engineer several dozen. New technologies are needed to unlock the bacterial kingdom's potential to impact many challenges of interest to mankind.

In this presentation we will show recent work utilizing novel microfluidic approaches to enable electroporation-based genetic transformation for applications in synthetic biology. In electroporation, high electric fields disrupt the cell envelope to introduce foreign nucleic acids. We have developed a rapid microfluidic assay to quantitatively measure the electric field conditions required to open pores in bacteria using electroporation. Our rapid microfluidic electroporation assay can evaluate a range of electroporation conditions in a fraction of a second, a process that previously took hours or even days.

Further, we have recently devised a microfluidic platform for high throughput electroporation that can enable genetic transformation 103 104 times faster than conventional systems. Results of this work will broaden the scope of bacteria available for applications ranging from biofuel production to human microbiome based therapeutics.