

Dr. Patrick Doyle, MIT

Flow Lithography to Create Encoded Microparticles

Abstract: Microparticles find use in a broad range of settings ranging from biosensing to consumer products to fundamental colloid studies. Advanced applications drive the demand for more complex particles with enhanced functionality. This talk will discuss our efforts in developing encoded microparticles using Stop Flow Lithography (SFL). Our SFL synthesis process couples the precise control of flow afforded by microfluidics and the sculpting of light by UV lithographic patterning. The method is general to any free radical polymerization and leverages inhibition layers created by oxygen near the microfluidic channel walls. I will first describe the fundamental transport processes at play in SFL and give demonstrative examples of particles which can be synthesized, ranging from soft blood cell mimics to ceramic gears. Next, I will discuss two methods to encode information into the particles, their relative merits and accompanying methods to decode rapidly them. Applications in the multiplexed detection of microRNA and object authentication will be discussed.

Bio: Patrick S. Doyle is the Singapore Research Professor in the Chemical Engineering Department at the Massachusetts Institute of Technology. He received his Ph.D. from Stanford University and was a postdoctoral fellow at the Institute Curie in Paris. A major theme of his research is the translation of molecular understanding of transport phenomena into new microfluidics-based processes. His lab studies a number of problems in soft matter with an emphasis on single molecule DNA dynamics, polymer physics, microrheology, and microfluidic processes. He has developed new methods for the synthesis of complex microgel particles by combining microfluidics and lithography in a process called Flow Lithography. One application is barcoded microgel particles for multiplexed biosensing. In 2010 he cofounded the company Firefly Bioworks which is commercializing these barcoded particle technologies. Among his awards are a NSF Career Award, 3M Innovation Award, Royal Society of Chemistry Pioneer in Miniaturization, Rothschild-Yvette Mayent Award, and Guggenheim Fellow. He has delivered several named Lectureships, including the Colburn Memorial Lecture, Thiele Lectureship, Van Ness Lectures, Stratis V. Sotirchos Memorial Lectureship and Royal Society of Chemistry Soft Matter Lectureship.