Microfluidic Technologies to Manufacture Soft Matter Materials

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ABSTRACT  In this talk I will describe how microfluidic technologies and various fields (light, temperature and flow) can be used to synthesize new functional soft matter materials. I will begin by introducing Flow Lithography - a new way of interfacing lithography and microfluidics to “optically stamp” complex and functional microparticles. This technique takes advantage of the unique ability to finely structure flows and chemical gradients in microfluidic devices. The process allows one to create particles with complex non-spherical shapes, chemical patterns, and loaded cargo. After describing the fundamental aspects of the process, I will describe applications of the complex particles ranging from multiplexed bioassays to anti-counterfeiting to drug delivery. I will also describe new flow-through arrays which are capable of generating large-scale particle arrangements.

BIO  Dr. Patrick Doyle is the Robert T. Haslam Professor of Chemical Engineering at the Massachusetts Institute of Technology. His research focuses on fundamental and applied topics in soft matter. Much of his research is the area of micro/nanofluidic technologies, DNA biophysics, biosensing and nanoemulsions. A burgeoning interest is the use of microfluidics to synthesize microparticles for both fundamental colloidal studies and applications, such as multiplexed sensing, biomimetic systems and anti-counterfeiting. He obtained his B.S.E. degree from the University of Pennsylvania in 1992, and his Ph.D. from Stanford University in 1997, working with Eric Shaqfeh and Alice Gast. After postdoctoral work with Jean-Louis Viovy at the Institute Curie in Paris, he joined the Chemical Engineering Department at MIT in 2000. Among his honors are the NSF-Career Award (2003), RSC Pioneers of Miniaturization Prize (2008), John Simon Guggenheim Fellowship (2009), and the RSC Soft Matter Lectureship (2012). He has also delivered the Colburn, Thiele and Van Ness Memorial Lectures. He is the graduate officer of the Chemical Engineering Department and has won the Michael Mohr Outstanding Faculty Award in 2013 and 2014 for his teaching of undergraduate fluid mechanics. He has co-founded two startup companies – Firefly Bioworks (founded in 2010, acquired by Abcam in 2015) and Motif Micro (founded in 2015, acquired by YPB Systems in 2018).