“ Expansion Microscopy and Implosion Fabrication”

Abstract:

We have developed strategies using swellable polymers to physically magnify objects such as biological specimens, by densely permeating them with a mesh of swellable polymer, anchoring specific molecules to the polymer, and then swelling the polymer (by adding water) to pull the molecules away from each other. This strategy, which we call expansion microscopy, is isotropic down to the nanoscale, and is in widespread use in biology for nanoimaging, because it lets one perform nanoimaging with an ordinary microscope. Running the strategy in reverse -- starting with a swollen polymer, depositing different materials throughout the polymer material at specific locations (e.g., via photopatterning), and then shrinking the polymer -- enables the deposited materials to be brought together into nanoscale register, and thus is an inexpensive way to create nanopatterns of interesting and useful materials. We call this methodology implosion fabrication. In this talk I will discuss how we developed these strategies, how they work, where they are headed, and their implications for photonics design, prototyping, and manufacture.

Bio:

Ed Boyden is Y. Eva Tan Professor in Neurotechnology at MIT, an investigator of the Howard Hughes Medical Institute and the MIT McGovern Institute, and professor of Brain and Cognitive Sciences, Media Arts and Sciences, and Biological Engineering at MIT. He leads the Synthetic Neurobiology Group, which develops tools for analyzing and repairing complex biological systems, such as the brain, and applies them systematically to reveal ground truth principles of biological function and to repair these systems. He co-directs the MIT Center for Neurobiological Engineering, which aims to develop new tools to accelerate neuroscience progress, and is a faculty member of the MIT Center for Environmental Health Sciences, Computational & Systems Biology Initiative, and Koch Institute. Amongst other recognitions, he has received the Wilhelm Exner Medal (2020), the Croonian Medal (2019), the Canada Gairdner International Award (2018), the Breakthrough Prize in Life Sciences (2016), the Grete Lundbeck Brain Prize (2013), and the NIH Director's Pioneer Award (2013), and is an elected member of the National Academy of Sciences (2019), the American Academy of Arts and Sciences (2017), the National Academy of Inventors (2017), and the American Institute for Medical and Biological Engineering (2018).