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Dynamic Control of F-actin Polymerization Using Electrical Interfaces IAN Y. WONG, Materials Science and Engineering, Stanford University, MATTHEW J. FOOTER, Biochemistry, Stanford University, NICHOLAS A. MELOSH, Materials Science and Engineering, Stanford University — The cytoskeletal biopolymer F-actin plays a crucial role in the mechanics and motility of eukaryotic cells and is also a model system for the investigation of the physics of semiflexible polymers. Historically, the polymerization of reconstituted F-actin has been initiated in vitro by increasing the bulk ion concentration from reduced to physiological levels. In this work, nanoscale electrodes are used to achieve spatial and temporal control of F-actin polymerization. The application of a low-frequency AC voltage alternately concentrates divalent cations and negatively charged G-actin monomers at the electrode surface, promoting highly localized polymerization. Unlike bulk polymerization, the kinetics of this electronically activated polymerization are governed by two competing mechanisms: ionic activation through Mg^{2+} binding and nucleation of actin trimers. Additional control can be achieved through the superposition of a high-frequency AC signal to align and trap filaments through dielectrophoresis. This combination of low and high frequency AC voltages may allow for the dynamic assembly of nanostructures with precisely controlled size and registry.

Ian Y. Wong
Materials Science and Engineering, Stanford University

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