How actin network dynamics control the onset of actin-based motility

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Cells use their dynamic actin network to control their mechanics and motility. These networks are made of branched and growing filaments. Here we study under which conditions such networks are able to build up a stress and display mechanical properties. Hard beads coated with a nucleating promoting factor are placed in a minimal protein system containing actin, the Arp2/3 complex, Capping Protein, and profilin. We parallelize experiments and simulations and find that gel heterogeneities observed around the beads do not always lead to symmetry breaking and comet formation, due to the molecular structure of the network and how it grows. Actin gel morphology around the beads is directly related to the balance between filament nucleation and capping. We propose a predictive morphology diagram linking the molecular and physical properties of growing actin gel. Therefore, in motile cells, a small change in protein concentration can thus lead to a dramatic change in cell mechanics and motility.