In Vitro Studies of Actin Network Assembly and Mechanical Failure

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We investigated the connection between local mechanical forces and actin network rupture using an in vitro motility system reconstituted from purified components. In the presence of the Arp2/3 complex and capping protein, spherical beads uniformly coated with the nucleation-promoting factor ActA grow a symmetrical actin network. Accumulation of mechanical strain in the growing network causes a rupture that breaks the network's symmetry and leads to directed motility. To determine the connection between local mechanical stresses and actin network rupture, we studied symmetry breaking around ellipsoidal ActA-coated beads of various aspect ratios. We observed several modes of symmetry breaking with distinct geometries. The frequency with which each mode was observed depends on the aspect ratio of the bead. Beads with high aspect ratios (>2) tended to break symmetry via fissures running parallel to the long axis of the bead. This result suggests that overall contour length is more important than local curvature in determining the site of mechanical rupture, as predicted by a computational model (see accompanying poster).