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Molecular motor-induced instabilities and crosslinkers determine biopolymer organization DAVID SMITH, University of Leipzig, Institute for Soft Matter Physics, FALKO ZIEBERT, Universitaet Bayreuth, DAVID HUMPHREY, CYNTHIA DUGGAN, University of Texas at Austin, CNLD, WALTER ZIMMERMANN, Universitaet Bayreuth, JOSEF KAES, University of Leipzig, Institute for Soft Matter Physics — All eukaryotic cells rely on the active self-organization of protein filaments to form a responsive intracellular cytoskeleton. The need for motility and reaction to stimuli additionally requires pathways that quickly and reversibly change cytoskeletal organization. While thermally-driven order-disorder transitions are, from the viewpoint of physics, the most obvious method for controlling such organization, the timescales necessary for effective cellular dynamics would require temperatures exceeding the physiologically viable temperature range. We report a mechanism whereby myosin II can cause near-instantaneous order-disorder transitions in reconstituted cytoskeletal actin solutions. When motor-induced filament sliding diminishes, the actin network structure rapidly and reversibly self-organizes into various assemblies. Addition of stable crosslinkers was found to alter the architecture of ordered assemblies. These isothermal transitions between dynamic disorder and self-assembled ordered states illustrate that the interplay between passive crosslinking and molecular motor activity plays a substantial role in dynamic cellular organization.

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