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Active turnover regulates pattern formation and stress transmission in disordered acto-myosin networks PATRICK MCCALL, SAMANTHA STAM, DAVID KOVAR, MARGARET GARDEL, University of Chicago — The shape and mechanics of animal cells are controlled by a dynamic, thin network of semiflexible actin filaments and myosin-II motor proteins called the actomyosin cortex. Motor-generated stresses in the cortex drive changes in cell shape during cell division and morphogenesis, while dynamic turnover of actin filaments dissipates stress. The relative effects that force generation, force dissipation, and disassembly and reassembly of material have on motion in these networks are unknown. We find that cross-linked actin networks in vitro contract under myosin-generated stresses, resulting in partial filament disassembly, the formation of asters, and clustering of myosin motors. We observe a rapid restoration of uniform polymer density in the presence of the assembly factors which catalyze network turnover through elongation of severed actin filaments. When severing is accelerated further by the addition of a severing protein, network contraction and motor clustering are dramatically suppressed. We test the relative effects of material regeneration and force transmission using image analysis, and conclude that the dominant mechanism for this effect is relatively short-lived stresses that do not propagate over considerable distance or push network deformation into the nonlinear contractile regime we have previously characterized. Our results present a framework to understand cytoskeletal active matter that are influenced by a complex interplay between stress generation, network reorganization, and polymer turnover.

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