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Biomimetic active emulsions capture cell dynamics and direct bio-inspired materials ALLEN EHRLICHER, ESTHER AMSTAD, JANA SEGMEHL, Harvard University, FUMIHIKO NAKAMURA, THOMAS STOSSEL, Harvard Medical School, MARTIN POLLAK, Beth Israel Deaconess Medical Center, DAVID WEITZ, Harvard University — The main biopolymers which make up the cellular cytoskeleton and provide cells with their shape are well understood, yet, how they organize into structures and set given cellular behavior remains unclear. We have reconstituted minimal networks of actin, a ubiquitous biopolymer, along with an associated motor protein myosin II to create biomimetic networks which replicate cell structure and actively contract when selectively provided with ATP. We emulsify these networks in 10-100 micron drops, provide a system to investigate strain-mediated protein interactions and network behavior in confined cell-similar volumes. These networks allow us to study strain-mediated protein-specific interactions in an actin network at a precision impossible in vivo. Using this system, we have identified strain-dependent behavior in actin cross linking proteins; mechanotransduction of signaling proteins in Filamin A, and unique catch-bond behavior in Alpha-actinin. This understanding of biopolymer self-organization to set cell mechanics, will help clarify how biology both generates and reacts to force; moreover this system provides a highly controlled platform for studying non-equilibrium materials, and creating microscopic building block for a entirely new class of active materials.

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