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Thermally Controlling the Polymeric Cytoskeleton in Living Cells

CHAO-MIN CHENG, PHILIP LEDUC, Department of Mechanical Engineering, Carnegie Mellon University — Cell structure is controlled to a large degree by the cytoskeleton, which is an intracellular polymer network. This cytoskeleton is critical as it strongly influences many cellular functions such as motility, organelle transport, mechanotransduction and mitosis. In our studies, we controlled the thermal environment of living cells and after applying an increase in temperature of only 5 ^{o}C, we observed a change in the polymer network as the actin filaments depolymerized. Interestingly, when we then lowered the temperature, the actin repolymerized indicating a reversible phase that is controlled by the thermal environment. We characterized the presence of F-actin and G-actin for these phases through analyzing the intensity from immunofluorescent studies for these proteins. The F-actin concentration decreased when increasing the temperature from the initial state and then increased when decreasing the temperature. Although the cell is known to be affected by heat shock responses, this is not a function of just the polymers as they do not exhibit these polymerization characteristics when we probed them as single filaments in vitro. These studies suggest that the cell has distinct phases or patterns while maintaining a reversible equilibrium due to the thermal environment for these networked polymers.

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