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Structure and Mechanics of Strained Surface-bound F-actin

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The mechanical response of cells under strain is strongly influenced by intermediate filaments, which enhance resilience and structural integrity. The actin cortex, tightly linked to the plasma membrane, plays a crucial role in cell shape, motility and mechanotransduction. However, its mechanical interplay with vimentin intermediate filaments remains poorly understood.

To systematically investigate this interaction, we are developing a reconstituted in vitro model system that enables controlled studies of actin organization under lateral stress. F-actin filaments are attached to an elastic polydimethylsiloxane (PDMS) substrate functionalized with silane and PEG-based linker, allowing controlled binding via the actin-membrane linker ezrin. This refined attachment strategy improves filament stability, mimics membrane linkage and enhances strain transmission. Using uniaxial stretching, we analyze actin mechanics under physiological strain conditions, providing insights into cytoskeletal adaptation.

Future experiments will integrate vimentin intermediate filaments to assess their influence on actin mechanics and cytoskeletal organization. By mimicking key aspects of the plasma membrane environment, this model system will offer fundamental insights into cytoskeletal resilience, advancing our understanding of cellular mechanics in migration, mechanosensing, and force transmission.