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Supported Lipid Bilayer Platforms to Probe Cell Mechanobiology

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Abstract

Mammalian and bacterial cells sense and exert mechanical forces through the process of mechanotransduction, which interconverts biochemical and physical signals. This is especially important in contact-dependent signaling, where ligand-receptor binding occurs at cell-cell or cell-ECM junctions. By virtue of occurring within these specialized junctions, receptors engaged in contact-dependent signaling undergo oligomerization and coupling with the cytoskeleton as part of their signaling mechanisms. While our ability to measure and map biochemical signaling within cell junctions has advanced over the past decades, physical cues remain difficult to map in space and time. Recently, supported lipid bilayer (SLB) technologies have emerged as a flexible platform to measure and manipulate membrane receptor mechanotransduction, allowing one to mimic cell-cell junctions. Changing the lipid composition and underlying substrate tunes bilayer fluidity, and lipid and ligand micro- and nano-patterning spatially control positioning and clustering of receptors. Patterning metal gridlines within SLBs introduces corrals that confine lipid mobility and introduce mechanical resistance. Here we review fundamental SLB mechanics and how SLBs can be engineered as tunable cell substrates for mechanotransduction studies. Finally, we highlight the impact of this work in understanding the biophysical mechanisms of cell adhesion.