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Hydrodynamic shear transmission across cellular membranes. DANIEL TAM, GUILLERMO AMADOR, MARIE-EVE AUBIN-TAM, TU Delft — A cell's interactions with the environment are mediated by its cellular membrane. This nanometer-thick, liquid crystalline structure is mostly composed of a lipid bilayer, which serves as a scaffold for embedded proteins and other macromolecules. Many crucial cellular processes, such as motion, growth, and proliferation, are dependent on external mechanical stresses; therefore, understanding how cellular membranes generate and transmit forces may shed light on cell behavior and homeostasis. In this study, we use optical tweezers to both apply and measure local forces on free-standing lipid bilayers within microfluidic channels. The planar geometry of the lipid bilayer facilitates interpretation of measurements using hydrodynamic models. This technique is the first to combine multiple optical tweezers probes with planar free-standing lipid bilayers accessible on both sides of the bilayer. The aims of these measurements are to quantify fluid slip close to and transmission of shear forces across the bilayer surface, building towards a fundamental understanding of the physical principles governing the transfer of forces by and through the membrane.

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