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Non-contact microrheology at the air-water interface[1]

THOMAS BOATWRIGHT, University of California, Irvine, ROIE SHLOMOVITZ, ALEX LEVINE, University of California, Los Angeles, MICHAEL DENNIN, University of California, Irvine — Mechanical properties of biological interfaces, such as cell membranes, have the potential to be measured with optical tweezers. We report on an approach to measure air-water interfacial properties through microrheology of particles near, but not contacting, the surface. An inverted optical tweezer traps beads of micron size or greater in the bulk, and can then translate them perpendicular to the interface. Through the measurement of thermally driven fluctuations, the mobility of the particle is found to vary as a function of submerged depth and the boundary conditions at the interface. Near a rigid wall, the mobility is confirmed to decrease in a way consistent with Faxèn's law. Very close to the free air-water interface, the mobility changes with the opposite sign, increasing by about 30% at the surface, consistent with recent calculations by Shlomovitz and Levine. In addition, the presence of a Langmuir monolayer at the interface is found to significantly change the mobility of the particle close to the interface. With an accurate theory, it should be possible to infer the shear modulus of a monolayer from the fluctuations of the particle beneath the interface. Since particles are not embedded in the monolayer, this technique avoids impacting the system of study.

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