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Membrane viscosity of surfactant and lipid bilayers measured by neutron spin echo MICHIHIRO NAGAO, Indiana U. and NIST, ELIZABETH KELLEY, NIST, ROBERT BRADBURY, Indiana U. and NIST, RANA ASHKAR, ORNL, PAUL BUTLER, NIST and Delaware U. — Membrane viscosity, μ, is a fundamental property of surfactant and lipid bilayers that determines the rate at which the membrane deforms and particles can diffuse through the membrane. Given its importance, several experimental methods have been suggested to determine μ, such as measuring the diffusion of lipid or tracer molecules in membranes or using a microfluidic technique to determine the two-dimensional velocity field slices. Here we calculate μ from measurements of the thermal undulation and thickness fluctuations using neutron spin echo (NSE) spectroscopy, as these motions are controlled by elastic and viscous properties of the membranes. Combining the NSE results with small-angle neutron scattering measurements to estimate the bilayer thickness, we determine μ together with the bending and area compressibility moduli of the membranes. We demonstrate the present method for lipid and oil-swollen surfactant bilayers. These membranes have orders of magnitude different elastic constants, and the values of μ extracted from the experiments span 0.01 to 50 nPa s m, which agree with some literature values.

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