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Water at a Janus Interface: An Exception to a Basic Assumption of Rheology YINGXI ELAINE ZHU, Univ. of Notre Dame, STEVE GRANICK, Univ. of Illinois at Urbana-Champaign — Understanding water at interfaces is important in fields ranging from biology to geology, yet the details are disputed. Using a surface forces apparatus, we have studied the mechanical response of molecularly-thin films of water confined between a hydrophobic surface on one side and a hydrophilic surface on the other side (a Janus interface) to shear. It is usually assumed that when a fluid is sheared, the observed shear force should be invariant to which surface is translated relative to the other. Surprisingly, we found that depending on which side of the interface was sheared, the nanorheological properties of water differ significantly. When the hydrophobic side was sheared, we observed time-averaged $G'(\omega)=G''(\omega)$ accompanied by enormous fluctuations. In contrast, when the hydrophilic surface was sheared, we observed a terminal relaxation time – classical Newtonian behavior. The identification of distinct rheology asymmetry suggests tentatively that the response to shear in these nanometer-thick fluids is controlled by in-plane diffusion rather than exchange of water molecules between surface and bulk, and provides a unifying perspective from which to analyze fluid viscosity in nanofluidic channels. In preliminary experiments, we have also studied hydrophobic surfaces mixed with variable amounts of polar functionality.

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