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Viscous friction of hydrogen-bonded matter AYKUT ERBAS, North Carolina State University, DOMINIK HORINEK, University of Regenburg, ROLAND R. NETZ, Free University of Berlin — Amontons' law successfully describes friction between macroscopic solid bodies for a wide range of velocities and normal forces. For the diffusion and forced sliding of adhering or entangled macromolecules, proteins and biological complexes, temperature effects are invariably important and a similarly successful friction law at biological length and velocity scales is missing. Hydrogen bonds are key to the specific binding of bio-matter. Here we show that friction between hydrogen-bonded matter obeys in the biologically relevant low-velocity viscous regime a simple equations: the friction force is proportional to the number of hydrogen bonds, the sliding velocity, and a friction coefficient γ_{HB}. This law is deduced from atomistic molecular dynamics simulations for short peptide chains that are laterally pulled over hydroxylated substrates in the presence of water and holds for widely different peptides, surface polarities and applied normal forces. The value of γ_{HB} is extrapolated from simulations at sliding velocities in the range from $v = 10^{-2}$ m/s to 100 m/s by mapping on a simple stochastic model and turns out to be of the order of $\gamma_{\mathrm{HB}} \simeq 10^{-8}$ kg/s. 3 hydrogen bonds act collectively.

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