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Wetting and Adhesion mediated by Nanoscale Capillary Bridges
SZU-PEI FU, Fordham University, SIJIA HUANG, Stony Brook University, YUAN-NAN YOUNG, New Jersey Inst of Tech, HOWARD STONE, Princeton University, CARLOS COLOSQUI, Stony Brook University — The formation of capillary bridges occurs in numerous natural and industrial processes involving the transfer of liquids between solid surfaces. This talk will discuss results from continuum-based models and fully atomistic molecular dynamics (MD) simulations of a nanoscale water bridge between two solid surfaces. For nanoscale separations between the solid surfaces, molecular interactions and thermal fluctuations significantly affect the capillary bridge shape, liquid-solid contact area, and equilibrium contact angles. For bridge heights below 10 nm, we observe significant differences between results from MD simulations and predictions from a conventional Young-Laplace equation considering solely the capillary pressure induced by free surface curvature. To account for results from MD simulations, we extended the Young-Laplace equation by including a disjoining pressure term due to DLVO interactions and steric effects. The proposed Young-Laplace equation is able to model nanoscale phenomena such as molecular layering that lead to strong structural forces and metastable configurations when the solid surfaces are separated by molecularly thin gaps.

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