Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

A thermodynamic model for the wetting characteristics of hierarchical physically-patterned surfaces[1] MICHAEL BELL, Department of Physics, Penn State University, University Park, PA 16802, AZAR SHAHRAZ, KRISTEN FICHTHORN, ALI BORHAN, Department of Chemical Engineering, Penn State University, University Park, PA 16802 — An understanding of wetting is important for many applications, including superhydrophobic self-cleaning and low-drag surfaces. Many natural examples of such surfaces exist, including insect legs, bird feathers, and plant leaves. The mechanism of superhydrophobicity on these surfaces is known to be related to their hierarchical roughness (i.e., roughness on micro and nano length scales), though the precise role of hierarchical roughness is not yet well understood. We present a two-dimensional thermodynamic model of the wetting of a hierarchically-grooved surface for droplets with variable Bond number. By investigating wetting phase diagrams over the microscale parameter space, we find that for negligible Bond number, surfaces with single-scale roughness are superhydrophobic only in small regions of the phase space–most notably in regions where the droplet is much larger than the size of the surface features–while the addition of nanoscale roughness greatly extends the range of drop sizes for which high contact angles are attained. We also investigate the case of non-negligible Bond number, for which we observe significant changes in the wetting phase diagram arising from gravity-induced interface deformations.

[1]This work was supported in part by NSF CBET 0730987.

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Date submitted: 14 Nov 2014 Electronic form version 1.4