Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Staying dry under water[1] PAUL JONES, Department of Mechanical Engineering, Northwestern University, EDUARDO CRUZ-CHU, Institute of Computational Science, ETH Zurich, CONSTANTINE MEGARIDIS, Department of Mechanical and Industrial Engineering, University of Illinois, JENS WALTHER, Institute of Computational Science, ETH Zurich and Department of Mechanical Engineering, Tech. University of Denmark, PETROS KOUMOUTSAKOS, Institute of Computational Science, ETH Zurich, NEELESH PATANKAR, Department of Mechanical Engineering, Northwestern University — Lotus leaves are known for their non-wetting properties due to the presence of surface texture. The superhydrophobic behavior arises because of the prevention of liquid water from entering the pores of the roughness. Present superhydrophobic materials rely on air trapped within the surface pores to avoid liquid permeation. This is typically unsustainable for immersed bodies due to dissolution of the air, especially under elevated pressures. Here, molecular dynamics simulations are used to demonstrate the non-wetting behavior of an immersed ten-nanometer pore. This is accomplished by establishing thermodynamically sustained vapor pockets of the surrounding liquid medium. Over 300,000 atoms were used to construct the nanopore geometry and simulate SPC/E water molecules. Ambient pressure was varied along two isotherms (300 K, and 500 K). This approach for vapor-stabilization could offer valuable guidance for maintaining surfaces dry even in a submerged state without relying on trapped air. The approach may be extended to control general phase behavior of water adjacent to textured surfaces.

[1]ISEN support is gratefully acknowledged

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Date submitted: 02 Aug 2012 Electronic form version 1.4