Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Convective Air Mass Transfer in Submerged Superhydrophobic Surfaces CHRISTINA A. BARTH, MOHAMED A. SAMAHA[1], HOOMAN VAHEDI TAFRESHI, MOHAMED GAD-EL-HAK, Virgina Commonwealth University
— Under pressure and flowing water, air entrapped in submerged superhydrophobic coatings eventually dissolve into the water. We analyze from first principles a simple mass transfer problem. We introduce an *effective* slip to a Blasius boundary layer, and solve the hydrodynamic as well as the mass transfer equations. Similarity solutions are found for both systems of equations. We then solve the two-dimensional problem of alternating free-shear and no-slip regions. This situation simulates spanwise microridges. The second problem has no similarity solution but is solvable using approximate integral methods. A mass-transfer correlation is achieved and relates the surface geometry (or gas area fraction) to the effective slip. The analytical results are compared to numerical simulations obtained via the FLUENT software for the laminar Navier–Stokes equations. Longevity, or time-dependent hydrophobicity, could be estimated for the simple laminar, flat-plate geometry investigated, and is compared to experimental results.

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Date submitted: 13 Jul 2012 Electronic form version 1.4