Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Enhancing Water Evaporation with Floating Synthetic Leaves[1]
JONATHAN BOREYKO, JOSHUA VIEITEZ, AUSTIN BERRIER, MATTHEW ROSEVEARE, WEIWEI SHI, Virginia Tech — When a wetted nanoporous medium is exposed to a subsaturated ambient environment, the water menisci assume a concave curvature to achieve a negative pressure. This negative water pressure is required to balance the mismatch in water activity across the water-air interface to achieve local equilibrium. Here, we show that the diffusive evaporation rate of water can be greatly modulated by floating a nanoporous synthetic leaf at the water's free interface. For high ambient humidities, adding the leaf serves to enhance the evaporation rate, presumably by virtue of the menisci enhancing the effective liquid-vapor surface area. For low humidities, the menisci cannot achieve a local equilibrium and retreat partway into the leaf, which increases the local humidity directly above the menisci. In light of these two effects, we find the surprising result that leaves exposed to an ambient humidity of 90 percent can evaporate water at the same rate as leaves exposed to only 50 percent humidity. These findings have implications for using synthetic trees to enhance steam generation or water harvesting.

[1]This work was supported by the National Science Foundation (CBET-1653631).

Jonathan Boreyko
Virginia Tech

Date submitted: 01 Aug 2017 Electronic form version 1.4