

Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Around a camphoric-acid boat, is the surfactant adsorbed on to the interface or dissolved in the bulk? SHREYAS MANDRE, Brown University, SATHISH AKELLA, DHIRAJ SINGH, Okinawa Institute of Science and Technology Graduate University, RAVI SINGH, Brown University, MAHESH BANDI, Okinawa Institute of Science and Technology Graduate University — A camphoric-acid boat (c-boat for short), a cylindrical gel tablet infused with camphoric acid, moves spontaneously when placed on an air-water interface. This system is a classic example of propulsion driven by Marangoni forces. Despite rich history on particles propelled by Marangoni forces, including contributions by figures such as Benjamin Franklin, Alessandro Volta, and Giovanni Venturi, the underlying fluid dynamics remains poorly understood. A key missing piece is the nature of the surfactant; in our case, the question is whether the camphoric acid is dissolved in the bulk or adsorbed on to the interface. We gain insight into this piece by holding the c-boat stationary and measuring the surrounding axisymmetric flow velocity to a precision needed to distinguish between the two possibilities. For soluble surfactants, it is known that the velocity field decays as $r^{-2/3}$, where r is the distance from the center of the c-boat. Whereas, for surfactant adsorbed on to the air-water interface, we derive that the surrounding velocity fields decays as $r^{-3/5}$. Based on our measurements we deduce that, even though soluble in water, the Marangoni flow results from a layer of camphoric acid adsorbed to the air-water interface.

Shreyas Mandre
Brown University

Date submitted: 01 Aug 2016

Electronic form version 1.4