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Wetting by surfactant solutions: The role of mass transfer through the contact line E. RAMÉ, NCSER, K. VARANASI, B. LUOKKALA, S. CONROY, S. GAROFF, Carnegie Mellon University — Surfactants affect wetting dynamics dramatically compared to pure fluids. Theory for insoluble surfactants shows that the rate of surfactant transfer between the free surface and the solid through the contact line can have important consequences for the dynamic contact angle. Simple observation of the wetting behavior of soluble surfactants makes clear the dramatic impact this transfer has on wetting. For systems with strongly attractive surfactant-solid interaction, receding surfactant solutions leave behind surfactant adsorbed at the solid-vapor interface. By contrast, when this interaction is weak, the solid emerges with much less surfactant. To get to the solid-vapor interface, a very complex mass transfer and surfactant rearrangement must occur as the surfactant exchanges among the solid/liquid, solid/vapor and liquid/vapor interfaces, as well as the bulk. We show that all four of these channels play a significant role in the mass transfer and that altering this mass transfer by changing the surfactant-solid interaction has a major impact on the flow fields and mass balance near moving contact lines. We also show that Ca_c, the critical capillary number for transition from receding contact line to film pulling, exhibits a discontinuous jump around 0.45 cmc. This jump cannot be explained by the concentration dependence of fluid properties or the static contact angle.

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