Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

The Surprising Influence of Marangoni Stress on Near-Singular Dynamics in Breaking Surfactant-covered Liquid Threads PRITISH KAMAT, Dow Incorporated., OSMAN BASARAN, Purdue University — The singularity arising during thread breakup is a precursor to drop formation and is accompanied by flows directed away from the breakup location that grow stronger as pinch-off nears. When surfactants are present at interfaces, these outward flows convect surfactants away from the singularity such that the dynamics proceeds in local absence of surfactants. Despite this, it has been observed that even small amounts of surfactants can have a substantive effect on breakup. Experiments show reduced rates of thinning, altered satellite sizes, and formation of fractal structures—microthread cascades—whereas simulations show that thinning filaments can recover and escape pinch-off in the presence of surfactants. Here, we show that evacuation of surfactants from the breakup singularity indirectly leads to the generation of large concentration (surface tension) gradients in the vicinity of but not at the breakup location. The resultant gradients generate Marangoni stresses that are large enough to compete with other forces, and are key to how surfactants influence near-singular dynamics. Here, we use simulations to shed light on two distinct contexts where the competition between Marangoni stresses and other forces perceptibly influences the fate of the breakup singularity.

Pritish Kamat
Dow Incorporated.

Date submitted: 31 Jul 2019 Electronic form version 1.4