Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Fingering instability in Marangoni spreading on a deep layer of polymer solution[1] XUE MA, MENGLIN ZHONG, YIFENG HE, ZHANWEI LIU, ZHENZHEN LI, Beijing Institute of Technology, GROUP OF APPLIED FLUID MECHANICS, BIT TEAM — Marangoni spreading on a complex fluid has a wide application in nature and industry, due to the wide existence of complex fluids. Here we report on a fingering instability with a clearly identifiable leading edge during Marangoni spreading on the free surface of a deep layer of polymer solutions, which is counterintuitive for miscible drop and substrate. The liquid surface morphology is measured by the Transmission Lattice Method with micron precision. The spreading radius is analyzed using a more generalized law than that of Newtonian fluids, involving viscoelastic and shear thinning effects. The origin of the fingering instability is explained by the elastic normal stress at a high shear rate, thus the surface is folded with a radius of curvature in the order of microns, and a high apparent contact angle is created at the leading edge where the fingering instability develops. The wavelength selection is explained in terms of a balance between the elastic normal stress and the elastic modulus of the polymer solution. Understanding the spreading mechanism has implication in airway drug delivery, and surface coating with patterns.

[1]ZZ. Li acknowledge the BIT Young researcher starting program, China NSFC, grant no. 11802023, the Shanghai Sailing Program, grand no. 17YF1409200, ZW. Liu acknowledge China NSFC, grand no. 11572041 for financial support.

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Date submitted: 28 Jul 2020 Electronic form version 1.4