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Electrostatic Assist of Liquid Transfer in Printing Processes
CHUNG-HSUAN HUANG, SATISH KUMAR, University of Minnesota — Transfer of liquid from one surface to another plays an important role in many printing processes. Incomplete liquid transfer can produce defects that are detrimental to the operation of printed electronic devices, and one strategy for minimizing these defects is to apply an electric field, a technique known as electrostatic assist (ESA). However, the underlying physical mechanisms of ESA remain a mystery. To better understand these mechanisms, slender-jet models for both perfect dielectric and leaky dielectric Newtonian liquid bridges with moving contact lines are developed. Nonlinear partial differential equations describing the time- and axial-evolution of the bridge radius and interfacial charge are derived, and then solved using finite-element methods. For perfect dielectrics, it is found that application of an electric field enhances transfer of liquid to the more wettable surface. For leaky dielectrics, application of an electric field can augment or oppose the influence of wettability differences, depending on the direction of the electric field and the sign of the interfacial charge. The physical mechanisms underlying these observations will be discussed.

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