**Capillary Flow with Evaporation in Open Rectangular Microchannels**

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**Extended Abstract**

﻿Numerous applications rely upon capillary flow in microchannels for successful operation including lab-on-a- chip devices, porous media flows, and printed electronics manufacturing. Open microchannels often appear in these applications, and evaporation of the liquid can significantly affect its flow. In this work, we develop a Lucas−Washburn-type one-dimensional model that incorporates the effects of concentration-dependent viscosity and uniform evaporation on capillary flow in channels of a rectangular cross section. The model yields predictions of the time evolution of the liquid front down the length of the microchannel. For the case where evaporation is absent, prior studies have demonstrated better agreement between model predictions and experimental observations in low-viscosity liquids when using a no-slip rather than a no-stress boundary condition at the upper liquid-air interface. However, flow visualization experiments conducted in this work suggest the absence of a rigidified liquid-air interface. The use of the no-stress condition results in overestimation of the time evolution of the liquid front, which appears to be due to underestimation of the viscous forces from (i) the upper and front meniscus morphology, (ii) dynamic contact angle effects, and (iii) surface roughness, none of which are accounted for in the model. When high-viscosity liquids are considered, the large bulk viscosity is found to suppress these factors, resulting in better agreement between model predictions using the no-stress condition and experiments. Model predictions are also compared to prior experiments involving poly(vinyl alcohol) in the presence of evaporation by using the evaporation rate as a fitting parameter. Scaling relationships obtained from the model for the dependence of the final liquid-front position and total flow time on the channel dimensions and rate of uniform evaporation are found to be in good agreement with experimental observations.