# Simultaneous Flow and Drying in Open Microchannels[1]

Robert K. Lade Jr., Christopher W. Macosko, and Lorraine F. Francis

Department of Chemical Engineering and Materials Science, University of Minnesota
421 Washington Ave. SE, Minneapolis, MN 55455

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Fluids are driven through microchannels in a variety of architectures, including microfluidic devices, micromolding patterns, and heat exchangers. Fluids that undergo drying can also be flowed through microchannels to coat or functionalize the channel surface, for example with catalysts (for microscale reactors[2]) or conductive materials (for printed electronics[3]). To date, little attention has been given to liquids that dry (i.e. experience solvent loss coupled to an increase in solids content/viscosity) during capillary-driven flow. In this work, we investigate the balance between flow and drying in open microchannels as well as the coupled dynamics of these two processes.

Using high speed visualization, we study the influence of drying on the capillary imbibition of aqueous polyvinyl alcohol solutions. Flow behavior is evaluated as a function of time, channel geometry, drying rate, and the presence of surfactant. Particle image velocimetry experiments are conducted to complement this investigation. Compared to non-drying liquids, drying reduces the total travel distance of the liquid in the channel and has a unique influence on the flow dynamics. Confocal Raman microscopy is used to characterize the drying dynamics in real time as a function of time, depth, and distance down the channel. Drying is shown to occur most quickly at the contact line, leading to a rapid, local increase in concentration and viscosity, which is ultimately responsible for stopping the flow.

This work has important applications in all processes involving the spreading of volatile solutions or suspensions, especially printing processes requiring the patterning of inks in microchannels or other confined volumes.

## References:


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