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Fluidic Control by Capillary and Maxwell Stresses for Liquid Printing of Small Metallic Structures GERRY DELLA ROCCA, SANDRA TROIAN, California Institute of Technology, MC 128-95, Pasadena, CA 91125 — Liquid dosing strategies for microfluidic applications normally rely on interior flow driven by external pressure gradients. To maintain a constant flow rate, the effective pressure drop over a given length conduit must scale inversely as the fourth power in the conduit radius, as prescribed by the Hagen-Poiseuille relation. For micron scale capillaries, this constraint requires enormous pressure gradients enforced by large pumps, cascades of tubing material, and electronic sensors. This burden, coupled with the likelihood of occlusions due to gas bubbles, contaminant or carrier particles, limits the usefulness of enclosed flow for transporting very small fluid volumes. Capillary flow on substrates etched with slender open grooves provides a much simpler, less expensive, efficient and reliable method of transport. When coupled with flow modulation by remote electric fields, the flow can be metered effectively and much more rapidly. We discuss the steady state, transient and oscillatory flow of a perfectly conducting liquid within an open conduit subject to a spatially and temporally varying electric field. The geometry investigated is geared toward applications involving liquid printing of small metallic elements for large-area circuits and photovoltaic displays.

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