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Wicking flow in optimized capillary channels BRUNO FIGLIUZZI, CULLEN BUIE, Massachusetts Institute of Technology — Many technological applications rely on the phenomenon of wicking flow induced by capillarity. However, despite a continuous interest on the subject, the influence of the geometry of the capillary channel on the dynamics of wicking is still poorly understood. In the case of a cylinder, the well-established Washburn law indicates that, at short time, the height of the rising liquid increases as the square root of time. However, Reyssat et al. demonstrated that shape variations affect the dynamics of the capillary rise at longer times. In numerous applications, being able to favor wicking in a capillary channel is a key issue. Starting from the Washburn-Lucas equation, we've developed a model describing the capillary rise of a liquid in a tube of varying circular cross-section. In this model, the dynamics of wicking is described by an ordinary differential equation whose second term depends on the shape of the capillary channel. Using optimal control theory, we have designed optimal shapes which favor wicking flow. Numerical simulations were conducted which show that the height of the rising liquid is up to 40 percent higher with the optimized shapes than with a cylinder tube of optimal radius.

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