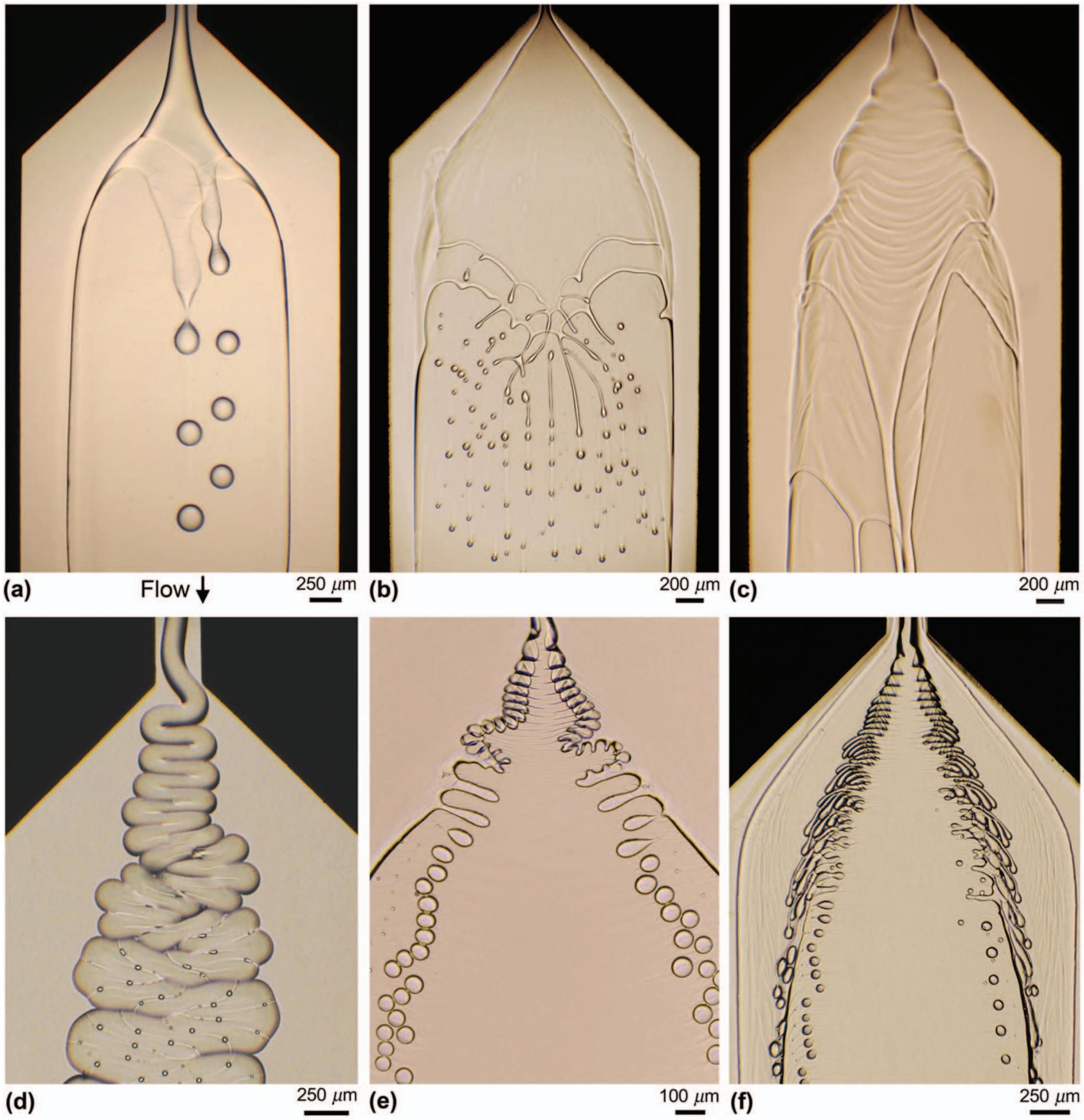

FIG. 1. (Color) Flow morphologies of partially wetting threads in planar microchannels of height $h=100$ or 250 μm (fluids: ethanol, mineral oils, and silicone oils). Dynamic wetting transitions: (a) pearl flow (thick lubricating film), (b) spider flow (thin lubricating film), (c) ghost flow (metastable dewetting patches). Droplet-decorated streams: (d) droplets-on-tracks (droplet formation along coalesced folds), (e) droplet side embedding (droplet inclusion by partial folding), (f) viscous droplet detachment (shear breakup of folds).

Wetting and lubricating film instabilities in microchannels

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This collection of experimental micrographs (Fig. 1) displays typical flow architectures observed during the lubrication failure of a partially wetting thread in a planar microchannel. Upstream, a steady viscous–core-annular flow is produced in a square microchannel[1] by focusing a high-viscosity liquid ($L1$) in a sheath of less viscous liquid ($L2$). Downstream, as the thread and surrounding liquid enter the slit microchannel, the thread enlarges and directly contacts the top and bottom glass walls. In the contact regions, the intercalated films of $L2$ between the dilated thread and the walls can partially dewet and breakup into droplets. Depending on flow rates and material properties, emulsification processes can be altered with the folding instability[2] to structure microflows and create local variations in the film thickness.

[1] T. Cubaud and T. G. Mason, "Capillary threads and viscous droplets in square microchannels," Phys. Fluids **20**, 053302 (2008).
[2] T. Cubaud and T. G. Mason, "Folding of viscous threads in diverging microchannels," Phys. Rev. Lett. **96**, 114501 (2006).

