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Microfluidic mixing through electrowetting-driven droplet oscillations FRIEDER MUGELE, RINA BAKKER, ADRIAN STAICU, Physics of Complex Fluids; University of Twente, JEAN CHRISTOPHE BARET, ISIS-ULP, Strasbourg, DAGMAR STEINHAUSER, MPI Dynamics and Self-organization, Goettingen — We used electrowetting to trigger periodic oscillations of millimeter-sized sessile droplets of water-glycerol mixtures in a viscosity range from 1 to 65 mPa s. We stained the drops partially with fluorescent dyes of variable mass to study the mixing within the droplets and we inserted tracer particles to characterize the flow patterns using particle image velocimetry (PIV). We found that mixing is completed within 100–2000 oscillation cycles for low and high viscosities, respectively. The absolute time for mixing is reduced by two orders of magnitude compared to pure diffusion. For dye molecules of variable mass, we find that the number of cycles required for mixing, scales with the logarithm of the Péclet number, in agreement with models based on chaotic advection. PIV data suggest that the origin of the irreversibility in the time-periodic flow fields inside the drop is related to the difference in contact angle between the spreading and the receding phase of the oscillatory drop motion. Part of the results was published in F. Mugele, J.-C. Baret, and D. Steinhauser. Appl. Phys. Lett. 88, 204106 (2006).

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