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Electrowetting-induced drop generation and control in a microfluidic flow-focusing device[1] FLORENT MALLOGGI, SIVA A. VANAPALLI, HAO GU, DIRK VAN DEN ENDE, FRIEDER MUGELE, University of Twente — Recent upsurge in droplet-based microfluidic research is fueled by the potential application of drops as well-controlled environments for biochemical reactions, single cell analysis and fluid logical devices. Commonly pressure driven flows are used to create droplets continuously either in a flow-focusing or in T-junction geometry. While this approach provides high throughput capability, it is neither amenable to detailed on-demand generation of individual drops nor to dynamic control of surface wettability, which can dramatically affect the dynamics of two-phase microflows. Alternatively, electrowetting (EW)-on-dielectric is used to digitally manipulate drops. The EW provides exquisite control over individual drops and surface wettability. However, current implementations have low throughput and cannot readily be integrated with existing channel-based technologies. Here, we adopt a unified approach to create a soft microfluidic platform that harvests the power of both methods and offers the capability to address their limitations. We achieve this integration by incorporating EW into a flow-focusing device and demonstrate EW-controlled drop formation. We identify experimentally the range of voltages and driving pressures that yields EW-induced droplet generation. A theoretical description based on the balance of external pressures and voltage-controlled capillary pressures quantitatively accounts for the observations. Moreover we show that the smaller the geometric scales the more efficient the electrowetting control of drop generation.

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