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Light-enabled digital microfluidics: A technology leading to a programmable lab on a chip STEVEN T. WERELEY, HAN-SHENG CHUANG, ALOKE KUMAR, Purdue University — We present a self-driven microfluidic device for droplet manipulations based on an open optoelectrowetting (O-OEW) technique. The proposed O-OEW features dynamic droplet maneuverability and great extensibility due to light-induced virtual electrodes and an open configuration. The device comprises coplanar interdigitated electrodes, a photoconductor, and an insulator on a single substrate. The mechanism behind the O-OEW is dependent on the impedance switching between the photoconductor and the insulator. The photoconductor works as a gate for the equivalent circuit. Under illumination the impedance of the photoconductor decreases, prompting an electrowetting effect due to a high voltage drop in the insulator. Without illumination the impedance of the photoconductor increases, shifting the voltage drop back to the photoconductor layer and shutting off the electrowetting. The illumination induces a localized hydrophilic region on an overall hydrophobic surface, causing an imbalance of surface tension forces and the subsequent liquid droplet movement. By selectively illuminating the platform surface, basic droplet operations are implemented, such as translation, merging, and simultaneous multi-droplet control. Immersing the liquid droplets in oil enhances the movements and prevents serious evaporation. For more high-end applications, an addressable light source, such as a DLP projector, can be employed. The integration will enable the realization of a programmable lab on a chip.

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