Electrowetting and Droplet Transport in Digital Microfluidic Chips for Mixing Applications

Sk. F. Azam[1]

[1]IIT Hyderabad, Hyderabad, Telangana, India

Abstract

Over the last decade, electrowetting-on-dielectric (EWOD) has become one of the most blistering and versatile tool in digital microfluidics. It enables control over fluid shape and flow by electrical signals alone, which is viable by effective utilization of the excess charge accumulation at the interface between the droplet and the dielectric surface, also by polarization of line tension at the three-phase line. The above-mentioned phenomenon has wide application range, particularly in the field of Lab-on-Chip (LOC), which is concerned with the design of micro total analysis system (μTAS) for chemical and biological applications. LOC designs allow multiple droplets to act as micro-reactors, by which multiple experiments can be performed on a single chip surface as each droplet is controlled by modifying control software through multiplexing.

The challenge in EWOD device is, the threshold voltage, used for clinical diagnostic to protect the cell from damage and to avoid cross talk between electrodes because of electrostatic effect to maintain droplet on proper track. This paper focuses on the effective simulation of 2D droplet transport on 3×3 array of electrodes without compromising the system performance, using the AC/DC and Microfluidics modules of COMSOL Multiphysics® software for droplet transport and mixing to calculate the resulting concentration of analyte in the mixed/merged droplet. The applied voltage and the minimum actuation force across different electrodes have been calculated varying with time, applied frequency, fluid conductivity and different layer height.