Design and Fabrication of Electrowetting Microfluidic Devices

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In this thesis, digital microfluidic chip based on electrowetting on dielectric has been studied. 1,000 Å of aluminum was deposited and patterned as control electrodes. Polymer thin film which gives cost effectiveness and easy process was coated as dielectric. Cross-linked poly vinyl alcohol, poly vinyl alcohol, poly vinyl acetate and poly styrene were compared. Teflon AF®, PECVD fluorocarbon and DDMS (dichloro-dimethylsilane) SAM (self-assembled monolayer) were compared and among them Teflon was finally adopted due to the lowest surface energy, the better smoothness and easier process. 2.0$\mu\ell$ droplet of d.i. water dispensed onto EWOD chip and linear transportation, zigzag motion, and rotation were successfully performed according to voltage switching programmed by LabVIEW software. Maximum frequency for droplet actuation was measured as 66.7 Hz at 160VDC and the velocity was 13.3 cm/s. 80-100 VDC is enough to manipulate droplet as fast as 20 Hz over 100s cycles. Droplet merging, mixing and splitting were performed as well.