Biao Tang（唐彪）[1], Zhongqian Sun（孙中谦）[1], Jan Groenewold[2], Guofu Zhou[3]

[1]Electronic Paper Display Institute , South China Academy of Advanced Optoelectronics, South China Normal University, Guangzhou 510006, P. R. China
[2]Van ‘t Hoff Laboratory for Physical and Colloid Chemistry, Debye Research Institute, Utrecht University, Padualaan 8, 3584 CH Utrecht, The Netherlands.
[3]Guangdong Provincial Key Laboratory of Optical Information Materials and Technology & Institute of Electronic Paper Displays, South China Academy of Advanced Optoelectronics, South China Normal University, Guangzhou 510006, P. R. China.

Abstract

Electrowetting on dielectric devices use a conducting (water) and insulating (oil) liquid phase, in conjunction, on a dielectric layer . In these devices, the wetting properties of the liquid phases can be manipulated by applying an electric field. The electric field can rupture the initially flat oil film and promotes further dewetting of the oil . Here we investigate a problem in the operation of electrowetting on dielectric caused by a finite conductivity of the oil. In particular, we find that the voltage at which the oil film ruptures sensitive to the application of relatively low DC voltages prior to switching. Here, we systematically investigate this dependence by controlled driving schemes. The mechanism behind these history effects point to charge transport processes in the dielectric and the oil, which can be modeled and characterized by a decay time. We used COMSOL Multiphysics 5.2a as the finite element modeling (FEM) solver to simulate the rupture behavior of oil film. Based on the charge transport equation and Gauss's law, electrostatic field calculations are performed on a hydrodynamically resolved fluid-fluid interface. In addition, a simplified yet accurate equivalent circuit model is developed to analyze larger data sets more conveniently. The experimental data support the hypothesis that each pixel can be characterized by a single decay time. We studied an ensemble of pixels and found that they show a rather broad distribution of decay times with an average value of about 440ms.

Figures used in the abstract

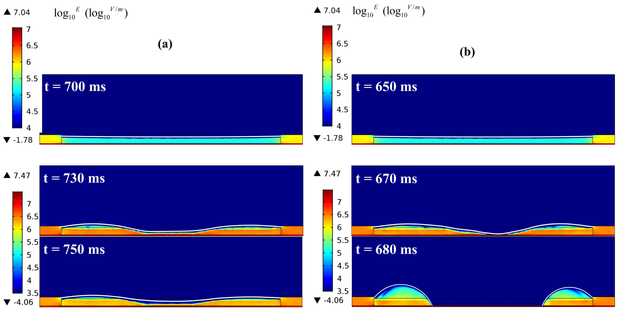

Figure 1: Electric field on a log-scale as obtained in the finite element simulation based on COMSOL. The meniscus position is indicated by the white line.