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Bistable electrowetting device with non-planar designed controlling electrodes for display applications

Key words: Bistable electrowetting; Non-planar; Controlling electrodes; Low voltage; High contrast

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Introduction

Electrowetting display (EWD) has advantages over liquid crystal displays (LCDs), including low power consumption, wide viewing angles, and high brightness. EWDs surpass the commercialized electronic paper (e-paper) technologies, such as those based on electrophoretic technology (Comiskey et al., 1998), in terms of video speed and full color mode operation.

EWD is a promising low-power electronic paper technology, because power is consumed only during the switching between two stable states, and there is no power consumption for state maintenance.

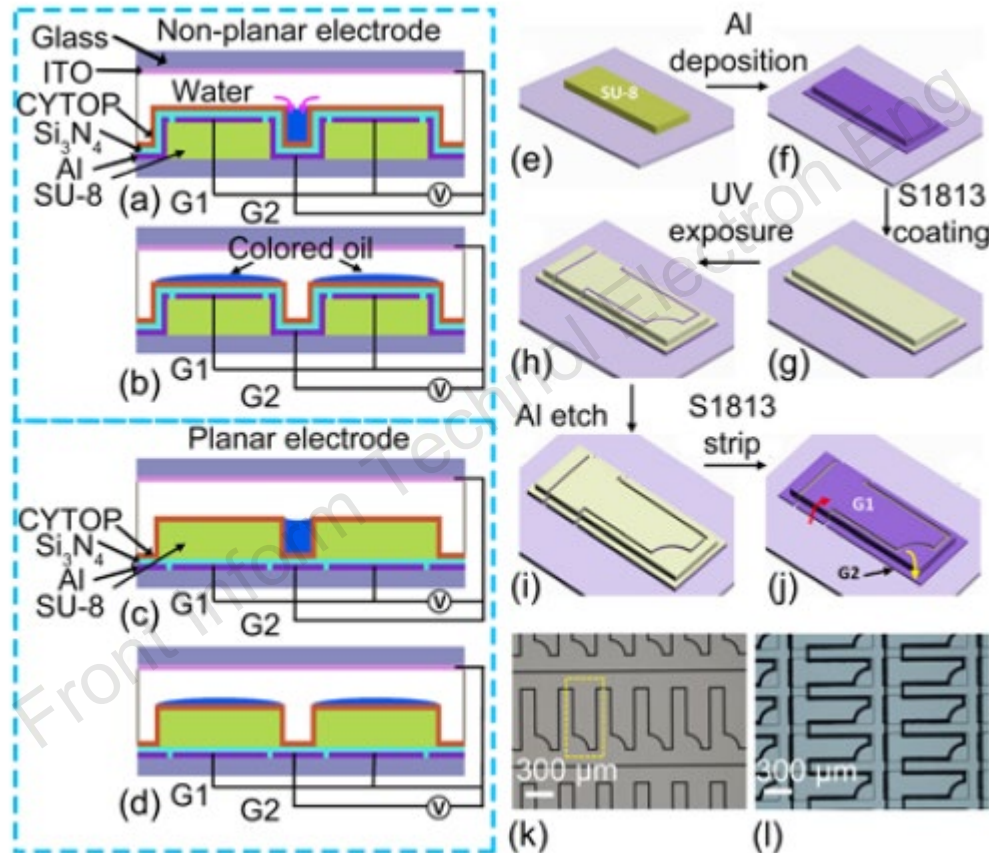
However, a large operating voltage, about 80–140 V, is needed to switch pixels for the reported bistable EWDs.

Main idea

In the previously reported bistable EWDs, a planar electrode structure has been used to control the state of liquid droplets. A thick dielectric layer exists between the electrodes and the liquid, so that very large voltages are required to control the droplet.

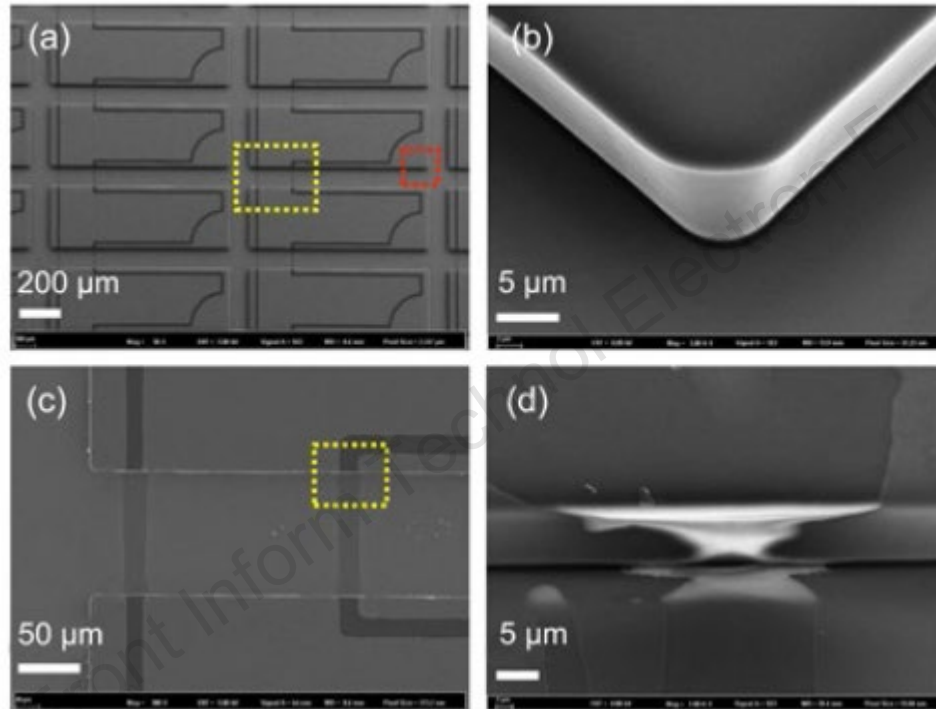
To reduce a controlling voltage, we proposed a non-planar electrode design, which is fabricated by a fully conventional photolithography process. The device has potential for video display applications with a controllable gray scale.

Method



Schematic of the structure and working principle of the non-planar and planar bistable electrowetting devices

Major results



Fabrication results of non-planar electrodes

Al was deposited continuously across the SU-8 step, and the pixel and channel electrodes were isolated on the sidewall of a pixel.

Major results (Cont'd)

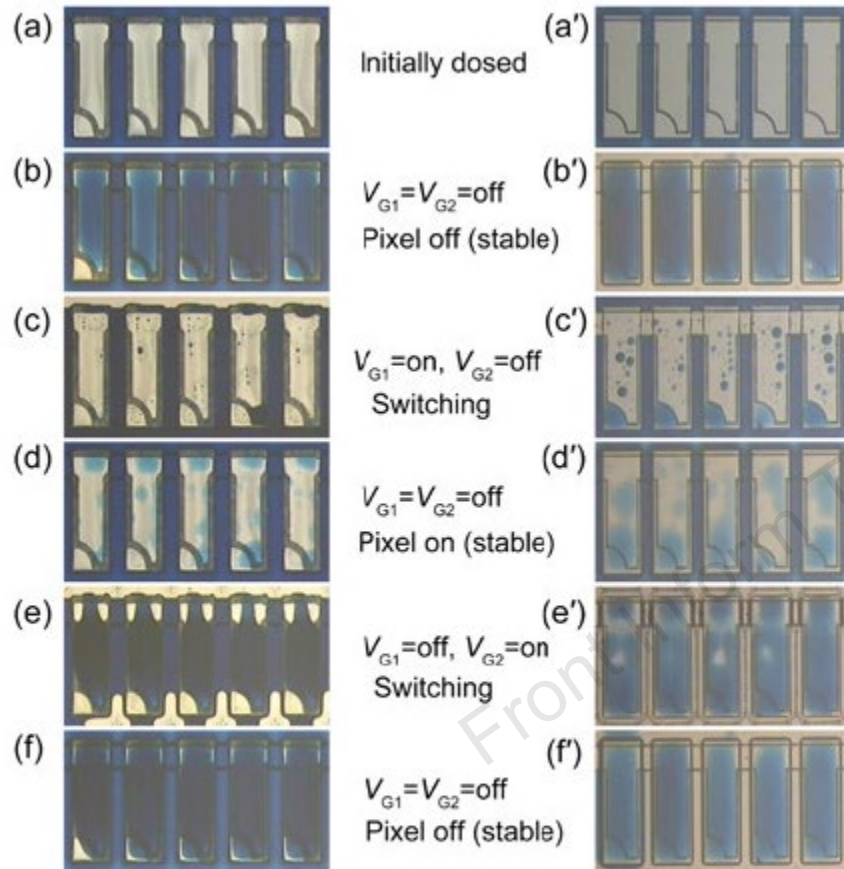


Fig. 3 Optical images of the devices while switching between two stable states for non-planar (a–f) and planar (a'–f') electrowetting devices

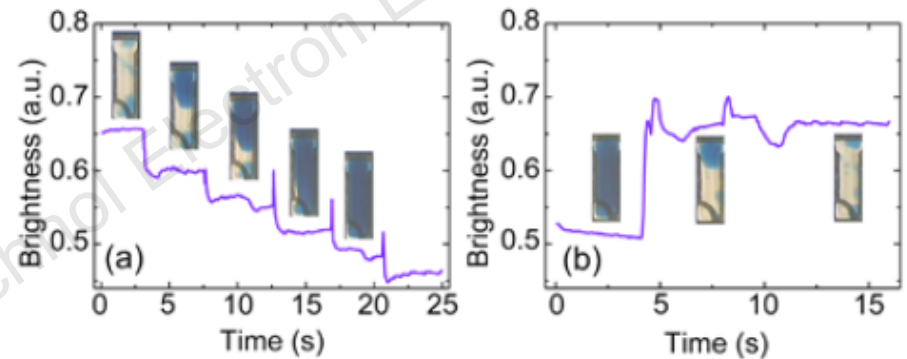


Fig. 4 Pixel brightness changes when it is switched off (a) and on (b)

The spike was not captured for some pulses which were too fast. Insets are images of pixels when the oil was relaxed

Conclusions

- A bistable EW device with non-planar controlling electrodes has been fabricated through a fully conventional lithographic process.
- The switching voltage has been reduced and the contrast ratio improved as compared with previously reported bistable EWDs with planar electrodes.