Electrowetting displays: 15 years and counting

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Electrowetting displays have been demonstrated since 2004. They have been subject to extensive investigation, and many (but not all) of the problems associated with the electrowetting phenomenon were solved. However, understanding the principle doesn't mean a working, attractive display can be made. Electrowetting displays could (and should) play an important role in a growing collection of display technologies, and will add significantly to our interaction with our environment, but is important to understand exactly how to implement and apply this technology. Maybe even more important: How not to apply it.

One of the challenges of electrowetting displays is the creation of a brightly reflecting color display. There is no obvious point in trying to make an "LCD replacement" and work with backlights, so the factor "reflectance" plays a very important role.
While reflective (monochrome) LCDs can reach almost 50% reflectance, any technology offering an improvement should surely significantly surpass this. Electrowetting displays claim just this. However, there seems to be a catch: Most display examples are configured in such a way that we can only expect 50% – 60% reflectance: only marginally better than LCD. In order to make a difference, reflectance will need to be >80%! This means some radical improvement in today's architecture must be made, and in particular pixel size and dye film thickness play the determining roles (see figure 1).

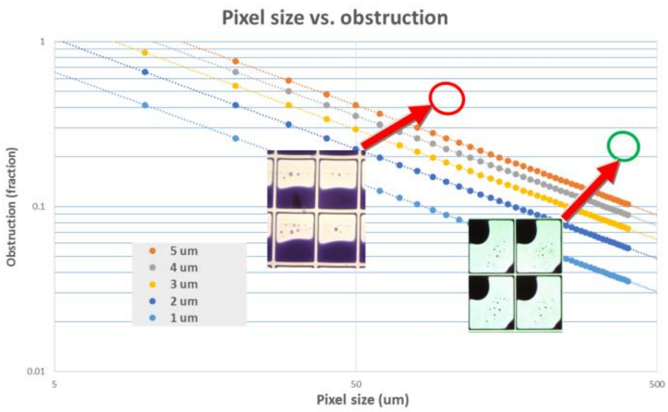

Figure 1: Pixel obstruction vs. size and ink thickness: Simplified theory and practice

Once reflectance is under control, a choice must be made regarding the color system: RGB color filter additive or CMY multi-layer subtractive color. Aperture provides the key to which one is preferred. Surprisingly, this is not a simple choice for one or the other.
The remaining properties to make a useful display are switching speed and power consumption. The former has always been a strong point of electrowetting displays, although controlling the switching flow can be challenging, but control is possible by electrical and mechanical (capillary) means. The latter presents a complex problem, since electrowetting displays need a high voltage to switch, and although a current is not required, keeping the power low puts a high demand on the insulating properties of the insulator.

With most of the problems solved, or at least with a feasible solution within reach, electrowetting displays will soon become a part of the ever growing commercial display family.

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