Application of Nanotechnology to liquid crystal displays

H S Kwok, Z L Xie and Fion Yeung

Center for Display Research, Hong Kong University of Science and Technology
Clear Water Bay, Hong Kong

Abstract

We shall report new results on the application of nanotechnology to LCD. Specifically we shall discuss the presence of nanoparticles in a liquid crystal mixture and a new method of preparing nanostuctures as the alignment layer.

Summary

We describe here two experiments on the application of nanotechnology to liquid crystal displays. These new experiments will enable the fabrication of novel devices. Heretofore, alignment layers for LCD are mostly homogeneous layer of polyimide. Rubbing of this PI layer produces reliable alignment and anchoring of the LC molecule near the alignment surface. The alignment layer has to be as uniform as possible in order not to induce any defects in the display. In this study, we explore the use of an inhomogeneous layer as the alignment surface. If the inhomogeneity is submicron in size, it turns out that there is no visible defect in the LCD. Moreover, the new inhomogeneous alignment layer will take on interesting properties that can be controlled by the properties of the domains. Such inhomogeneous surfaces are called nano-structured alignment surfaces (NAS).

Take for example, an inhomogeneous mixture of vertical (V) and horizontal (H) alignment domains [1]. If the mixture is random and more or less evenly distributed, the resultant NAS will produce a pretilt angle that is in between V (a few degrees from the surface normal) and H (a few degrees from surface). In fact, any pretilt angle can be produced this way. The detail of this interaction of the nano-domains to produce the resultant NAS will be described in detail in the presentation. Fig. 1 shows the results. It can be seen that the resultant pretilt angle depends critically on the areal ratio of the V and H domains.

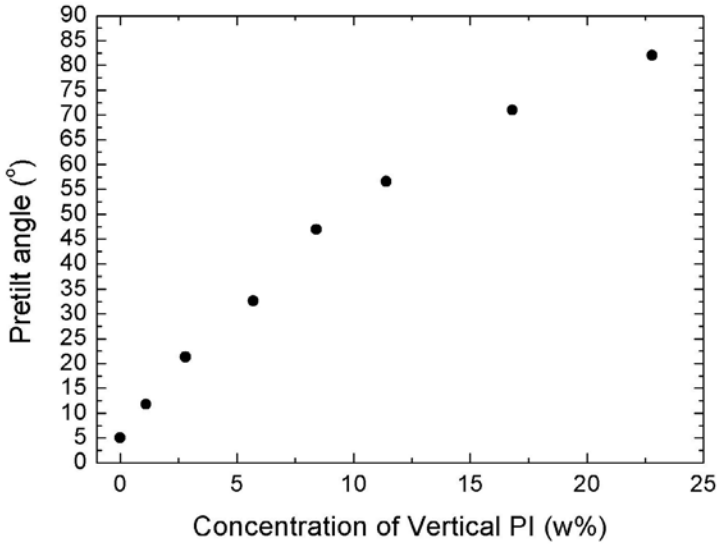

Figure 1.

Another example of the application of nanotechnology to LCD is the addition of nanoparticles to the LC itself [2,3]. Several groups are working in this direction. It turns out that the nanoparticles can produce interesting properties in the LC. Depending on the optical properties of the nanoparticles, which may be metallic or semiconducting or dielectric, the LC can take on different dispersive properties. One application of this technology is in reducing the operating voltages of displays.

References

1. F S Yeung, F C Xie, O Tsui, P Sheng and H S Kwok, to be published.
2. D Sikharulidze, Appl Phys Lett, 86, 33507 (2005).
3. Y Shiraishi et al, Appl Phys Lett, 81, 2845 (2002).