LIQUID CRYSTAL DEVICE AND ELECTRONIC APPARATUS

CROSS REFERENCES TO RELATED APPLICATIONS

[0001] The present invention contains subject matter related to Japanese Patent Application No. 2009-009615 filed in the Japanese Patent Office on January 20, 2009, the entire contents of which are incorporated herein by reference.

BACKGROUND

1. Technical Field

[0002] The invention relates to a liquid crystal device and an electronic apparatus.

2. Related Art

[0003] Hitherto, as one means for achieving a wide viewing angle of an liquid crystal device, there has been used a mode in which an electric field is applied to a liquid crystal layer in a direction of a substrate plane to thereby control alignment of liquid crystal molecules (such a mode will be referred to as a lateral electric field mode), and an IPS (In-Plane Switching) mode and an FFS (Fringe-Field Switching) mode have been known as such a lateral electric field mode. In a lateral electric field mode liquid crystal

device, a pixel electrode and a common electrode are typically formed on the same substrate. In the case of the IPS mode, the pixel electrode and the common electrode are formed on the same layer and have a comb-teeth shape. On the other hand, in the case of the FFS mode, the pixel electrode and the common electrode are formed on different layers, respectively, and one of them has a comb-teeth shape and the other has a beta shape. In particular, in the case of the FFS mode, since the pixel electrode and the common electrode are formed on different layers, a strong electric field is generated from a fringe portion of the electrode in a direction inclined with respect to the substrate plane. Therefore, the FFS mode has a merit that the alignment of liquid crystal molecules disposed right above the electrode can be easily controlled compared with the IPS mode.

[0004] As a method for achieving a further wider viewing angle with the lateral electric field mode liquid crystal device, there is a known method that forms a plurality of regions, a so-called multi-domain, in which liquid crystal molecules within one sub-pixel are aligned in different directions upon voltage application (a region where liquid crystal molecules are aligned in approximately one direction is referred to as a domain). Since the viewing angle characteristics corresponding to inherent contrast ratios of respective domains are compensated by forming multiple

domains, it is possible to achieve a wide viewing angle. In order to form a multi-domain structure, the shape of a comb-teeth shaped electrode needs to be studied. When electrode fingers constituting a comb-teeth shaped electrode are referred to as "linear electrodes," rather than arranging the entire linear electrodes within one sub-pixel to extend in the same direction, for example, as illustrated in Fig. 11, linear electrodes 101a corresponding an upper half part of one sub-pixel are arranged to be inclined toward the top left corner in Fig. 11 and linear electrodes 101b corresponding to a lower half part thereof are arranged to be inclined toward the bottom left corner. A electric field is generated in a direction perpendicular to the extending direction of the linear electrodes 101a and 101b upon application of an electric voltage. Liquid crystal molecules are caused to be aligned in accordance with the electric field. In the case of Fig. 11, two regions (the upper half part and the lower half part of the sub-pixel) where liquid crystal molecules are aligned in different directions are generated, whereby a dual-domain structure is achieved.

[0005] Here, since a uniform lateral electric field is generated in portions (encircled region indicated by symbol A in Fig. 11) of an liquid crystal layer disposed in the vicinity of the center portions of the linear electrodes

101a and 101b, images can be properly displayed. However, since lateral electric fields are generated in various directions in portions (encircled regions indicated by symbol B in Fig. 11) of the linear electrodes 101a and 101b disposed in the vicinity of end portions thereof, the alignment of the liquid crystals is disordered, and thus, light transmittance during bright display is remarkably deteriorated at these locations. Therefore, in this configuration, the area capable of substantially contributing to display is decreased, and thus, it is difficult to obtain a sufficient aperture ratio of the pixel and to achieve a high display luminance. In this respect, there is proposed a multi-domain liquid crystal display device in which in lieu of the configuration of Fig. 11 where the linear electrodes are arranged to extend in a short-axis direction of the sub-pixel, the linear electrodes are arranged to extend in the long-axis direction of the sub-pixel (see Japanese Unexamined Patent Application Publication No. 2002-014374). Specifically, the pixel electrode and the common electrode are arranged to extend in the long-axis direction of the sub-pixel so that they are bent several times.

[0006] According to the configuration disclosed in Japanese Unexamined Patent Application Publication No. 2002-014374, since the area of the end portions of the linear

electrodes within one sub-pixel is small compared with the configuration illustrated in Fig. 11, it is possible to increase the area, which is able to substantially contribute to display, to thereby increase the aperture ratio of the pixel. However, since the pixel electrode and the common electrode are bent with respect to the sub-pixel having an approximately rectangular shape, there is generated a triangular dead space which does not contribute to display along the data line (the longer side of the sub-pixel), and thus, the aperture ratio is decreased in this portion. Consequently, there is a problem that it is difficult to achieve a high display luminance.

SUMMARY

[0007] An advantage of some aspects of the invention is that it provides a liquid crystal device having a high pixel aperture ratio, a high display luminance and a wide viewing angle and an electronic apparatus using the liquid crystal device.

[0008] According to an aspect of the invention, there is provided a liquid crystal device including a first substrate and a second substrate that are disposed to face each other; a liquid crystal layer that is sandwiched between the first substrate and the second substrate; a first electrode that

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