

**DISPLAY PIXEL USING ELECTROACTIVE
POLYMER AND DISPLAY APPARATUS
EMPLOYING THE SAME**

CROSS-REFERENCE TO RELATED PATENT
APPLICATION

[0001] This application claims the benefit of Korean Patent Application No. 10-2007-0050263, filed on May 23, 2007, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein in its entirety by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a display pixel reflecting color light using an electroactive polymer, and a display apparatus employing the display pixel and displaying a color image.

[0004] 2. Description of the Related Art

[0005] With the rapid development of communication technologies and display apparatuses, various kinds of portable terminals with a display unit have been introduced. Examples of the portable terminals include personal digital assistants (PDAs), portable multimedia players (PMPs), and digital multimedia broadcasting (DMB) phones. Liquid crystal displays (LCDs) are light-receiving flat panel displays (FPD) used in portable terminals or general display apparatuses. Because LCDs are not self-luminous, they display an image by modifying the transmittance of light emitted by a light source through each pixel. To this end, a backlight unit is installed at the back of the LCDs to emit light toward a liquid crystal panel.

[0006] Backlight units are classified into direct light type backlight units and edge light type backlight units according to the arrangement of light sources. Direct light type backlight units are configured such that a plurality of lamps disposed beneath a liquid crystal panel directly emit light onto the liquid crystal panel. The direct light type backlight units are suitable for large-sized display apparatuses of 30 inches or more, e.g., LCD TVs, because the light sources can be effectively located over a wide area with flexibility. Edge light type backlight units are configured such that a light source is located on a sidewall of a light guide plate (LGP). The edge light type backlight units are suitable for portable terminals because the light source is located only on the sidewall of the LGP.

[0007] Recently, interest is growing on display apparatuses that can display an image using sunlight or external illumination without charging the display apparatuses.

[0008] However, since LCDs using external light use a color filter to create a color image and the color filter transmits light having a specific wavelength and absorbs remaining light, light efficiency is low. Since the color filter is expensive, the LCDs are also expensive. Accordingly, there is a demand for a method of creating a color image without a color filter.

SUMMARY OF THE INVENTION

[0009] The present invention provides a display pixel that reflects color light using an electroactive polymer.

[0010] The present invention also provides a display apparatus that displays a color image by reflecting external light as color light using an electroactive polymer.

[0011] According to an aspect of the present invention, there is provided a display pixel including: an electroactive polymer layer, of which shape and/or size is displaced when a voltage is applied thereto; a diffraction grating, of which a pitch and a diffraction angle change according to a displacement

of the electroactive polymer layer; and a liquid crystal layer which is disposed to cover the diffraction grating and controls gradation according to a voltage applied thereto.

[0012] The diffraction grating may be formed of a flexible conductive material.

[0013] The pixel further comprises a thin film transistor (TFT) electrode, which applies a voltage to the liquid crystal layer. The diffraction grating may be used as a top electrode of the TFT electrode.

[0014] The display pixel may further comprise a first and a second electrodes which each are formed of a flexible material and disposed on a bottom surface and on a top surface of the electroactive polymer layer, respectively, wherein the first and the second electrodes apply a voltage to the electrode active polymer layer and undergo deformation according to the displacement of the Electroactive polymer layer.

[0015] The electroactive polymer layer and the diffraction grating may be disposed in the liquid crystal layer.

[0016] The electroactive polymer layer may have a thickness ranging from 0.001 to 100 μm .

[0017] According to another aspect of the present invention, there is provided a display apparatus including a plurality of pixels, wherein each of the plurality of pixels comprises: a backlight unit emitting light; a liquid crystal layer controlling transmittance of the light emitted by the backlight unit according to a voltage applied to the liquid crystal layer; a reflective color unit including: an electroactive polymer layer, of which shape and/or size is displaced when a voltage is applied thereto; and a diffraction grating, of which a pitch and a diffraction angle change according to a displacement of the electroactive polymer layer; and a transmissive color unit including a color filter transmitting light having a specific wavelength among the light emitted by the backlight unit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The above and other features and advantages of the present invention will become more apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:

[0019] FIG. 1 is a cross-sectional view of a subpixel of a color display apparatus using an electroactive polymer according to an embodiment of the present invention;

[0020] FIG. 2 illustrates a circular displacement occurring when a voltage is applied to the electroactive polymer of a color reflecting unit of the color display apparatus of FIG. 1;

[0021] FIG. 3 illustrates a linear displacement occurring when a voltage is applied to the electroactive polymer of the color reflecting unit of the color display apparatus of FIG. 1;

[0022] FIG. 4A is a graph illustrating a relationship between a voltage applied to an electroactive polymer layer and the pitch of a diffraction grating of the color reflecting unit of the color display apparatus of FIG. 1;

[0023] FIG. 4B is a graph illustrating a relationship between a voltage applied to the electroactive polymer layer and the wavelength of light reflected by the diffraction grating of the color reflecting unit of the color display apparatus of FIG. 1; and

[0024] FIG. 5 is a cross-sectional view of a subpixel of a color display apparatus using an electroactive polymer according to another embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0025] Hereinafter, the present invention will be described more fully with reference to the accompanying drawings, in which exemplary embodiments of the invention are shown.