age V increases, the pitch d of the diffraction grating **115** increases. As the distance t between the first electrode **106** and the second electrode **110** increases, the pitch d of the diffraction grating **115** decreases. If the electroactive polymer layer **107** is thick, the displacement of the electroactive polymer layer **107** occurs only when a high voltage is applied. Accordingly, the electroactive polymer layer **107** may have a thickness ranging from 0.001 μm to 100 μm.

[0044] FIG. **4**A illustrates a relationship between a voltage applied to the electroactive polymer layer **107** and the pitch of the diffraction grating **115** of the color display apparatus of FIG. **1**. The diffraction grating **115** may be a reflective diffraction grating reflecting incident light such that the wavelength of light reflected by the diffraction grating **115** varies depending on the pitch of the diffraction grating **115**. When a voltage is applied to the electroactive polymer layer **107**, displacement of the electroactive polymer layer **107** occurs, the diffraction grating **115** is extended accordingly, and the pitch of the diffraction grating **115** is increased. Once the pitch of the diffraction grating **115** is increased, the diffraction grating **115** reflects light having a larger wavelength than that of incident light. FIG. **4**B illustrates a relationship between a voltage applied to the electroactive polymer layer **107** and the wavelength of light reflected by the diffraction grating **115** of the color display apparatus of FIG. **1**. It is found from FIG. **4**B that the wavelength of light reflected by the diffraction grating **115** can be adjusted by controlling the voltage applied to the electroactive polymer layer **107**. In FIGS. **4**A and **4**B, dotted lines represent measurements and solid lines represent calculations. It is disclosed in M. Aschwanden and A. Stemmer, Opt. Lett. 31(17), 2610 (2006), of which the content is incorporated herein by reference, that the wavelength of light reflected by a diffraction grating varies depending on a voltage applied to an electroactive polymer layer. The color display apparatus of FIG. **1** uses these properties of electroactive polymers.

[0045] The color display apparatus of FIG. **1** includes a plurality of pixels. Each of the plurality of pixels has a plurality of subpixels. Since the subpixels output different color light according to input signals, gradation is produced. The display apparatus of FIG. **1** employs the color reflecting unit **10** containing an electroactive polymer, which is strained when a voltage applied to the electroactive polymer, and creates a color image.

[0046] The operation of the color display apparatus of FIG. **1** will now be explained in detail.

[0047] The respective subpixels have an identical structure, and different color light is emitted by controlling voltages applied to the liquid crystal layer **120** and to the electroactive polymer layer **107**. Referring to FIG. **1**, a first voltage V**1** is applied to the liquid crystal layer **120** by the TFT electrode **103**. A second voltage V**2** is applied to the electroactive polymer layer **107** by the first electrode **106** and the second electrode **110** according to an image signal input from a control unit (not shown) of the color display apparatus. Among external light incident on the color display apparatus, only light having a specific polarization is transmitted through the polarization film **130**, and is converted into circularly polarized light by the quarter wave plate **127**. For example, P-polarized light may be transmitted through the polarization film **130** and may be converted into right circularly polarized light by the quarter wave plate **127**. Light passing through the transparent substrate **125** is incident on the liquid crystal layer **120** by which the transmittance of the light is controlled according to the first voltage V**1**, and then is incident on the diffraction grating **115**. The wavelength of light reflected by the diffraction grating **115** is controlled according to the second voltage V**2**. Light having a desired wavelength is reflected by the diffraction grating **115**, passes through the liquid crystal layer **120** and the transparent substrate **125**, and then is incident on the quarter wave plate **127**. Light converted into left circularly polarized light by the quarter wave plate **127** is converted into P-polarized light by the polarization film **130** and emitted to the outside of the color display apparatus.

[0048] For example, when one pixel includes first through third subpixels and second voltages V**2***a*, V**2***b*, and V**2***c* are respectively applied to the first through third subpixels, light having a larger wavelength is reflected by the diffraction grating **115** as a higher voltage is applied. For example, when the second voltages V**2***a*, V**2***b*, and V**2***c* satisfying a relationship of V**2***a*>V**2***b*>V**2***c* are applied, red light, green light, and blue light may be reflected by the diffraction grating **115**. The different color light emitted by the first through third subpixels is combined to produce desired color light.

[0049] Since the respective subpixels have the same structure and the different color can be emitted by controlling only the voltages applied to the electroactive polymer layer **107**, the color display apparatus can be easily manufactured at low cost. Also, since the color display apparatus does not absorb light, light efficiency is higher than a color display apparatus that creates a color image using a color filter.

[0050] FIG. **5** is a cross-sectional view of a color display apparatus according to another embodiment of the present invention. Referring to FIG. **5**, the color display apparatus includes a plurality of pixels each including a plurality of subpixels. Each of the plurality of subpixels includes a reflective color unit RM which reflects external light and displays a color image, and a transmissive color unit TM which transmits light emitted by a backlight unit **200** and displays a color image. Since respective subpixels have the same structure, only one subpixel will now be explained.

[0051] The reflective color unit RM has the same construction as that of the color display apparatus of FIG. **1**. The reflective color unit RM includes an electroactive polymer layer **213** of which size and/or shape is displaced when a voltage is applied thereto, and a diffraction grating **220** whose pitch is changed according to the displacement of the electroactive polymer layer **213** to change the diffraction angle and wavelength of light reflected thereby. The diffraction grating **220** reflects light having a certain wavelength as color light among external light with the help of the electroactive polymer layer **213**.

[0052] A first electrode **210** and a second electrode **215** are respectively disposed under and over the electroactive polymer layer **213** to apply a voltage to the electroactive polymer layer **213**. A liquid crystal layer **223**, which also extends to TM area, is disposed on the diffraction grating **220**, and a TFT electrode **205** applying a voltage to the liquid crystal layer **223** may be disposed under the electroactive polymer layer **213**. An insulating layer **207** is disposed between the first electrode **210** and the TFT electrode **205**. A support layer **217** may be disposed between the second electrode **215** and the diffraction grating **220**. The electroactive polymer layer **213** and the diffraction grating **220** may be disposed in the liquid crystal layer **223**, and more specifically may be disposed in middle and bottom areas of the liquid crystal layer **223**. A substrate **202** may be disposed under the TFT electrode **205**.