[0317] Such pitch control techniques can be used to make a fourth illustrative embodiment of the spectral filter structure herein shown in **FIG. 10**, wherein narrow-band blue-reflecting CLC material of pitch B**17** and a narrow-band green-reflecting CLC material of pitch G **18** are formed in a top portion **301** of layer **300**, whereas a narrow-band green-reflecting CLC material of pitch G **227** and a narrow-band red-reflecting CLC material of pitch R**228** are formed in a bottom portion **302** of layer **300**.

[0318] In this example, assume the cholesteric liquid crystals are left handed circularly polarized. The pitch of a cholesteric material can be tuned by varying the sample temperature: P(T). Starting with the bottom portion **302** of layer **300** a mixture of cholesteric liquid crystal material at one temperature has a pitch $P(T_L)=P_R$ reflecting red **228**. With other portions of the layer **300** masked, the red **228** portion of layer **302** is exposed to UV light of a specific wavelength which penetrates approximately half way through the layer **300** before it is totally attenuated. This UV light polymerizes the red portion **228** of layer **300**. The mask on the bottom portion **302** is removed revealing the green portion **227**. At a different temperature either higher or lower than the temperature polymerizing the CLC material for red **228** the temperature for polymerizing green **227** reflective CLC material is reached. UV light of a specific wavelength is then irradiated on the green portion **227** as above for the red **228**, such that the UV light is attenuated half way through the layer **300**. The bottom portion **227** of layer **300** is now polymerized. Layer **300** may be turned over. A mask is applied covering the blue portion **217**. The green portion **218** of layer **302** is polymerized by UV light at a UV wavelength which is attenuated half way through layer **301**. Alternatively a mask applied to the bottom layer **302** can be used and a UV light which will penetrate layer **225** to polymerize layer **301** can be used. With the temperature again adjusted to the temperature for reflecting blue light. The mask covering the blue portion **217** is removed and the layer **300** is exposed to UV light at a wavelength to penetrate half way through layer **300**.

[0319] If a layer is only partially polymerized at one temperature only part of the molecules acquire a periodicity for the color desired. When the temperature is changed, the LC molecules, that are not strongly anchored yet by the partial cross-linking, must adopt a different pitch. This pitch will not be the same as before since in the new environment they interact not only with free molecules like themselves but also with the strongly anchored LC molecules due to the previous partial polymerization.

[0320] With a series of small steps in temperature variation and UV penetration wavelengths a broadband of colors will be reflected by the layer **300**. Each incremental portion of layer **300** will have a band about a central wavelength that it reflects. With a continuous change in temperature linked to a continuous change in UV penetration wavelength, broadband reflective cholesteric liquid crystal color filters can be made about a central wavelength. Therefore broadband polarizers may be made with variable pitch cholesteric liquid crystal materials by varying the temperature gradient and UV penetration gradient in a coordinated manner for example by changing the temperature of a hotplate in conjunction with changing the UV frequency such that the change in pitch in the cholesteric liquid crystal material is polymerized for a broadband reflective CLC material layer.

[0321] The above technique can be used to make the spectral filter shown in **FIG. 14**. In this filter structure, the broadband reflective portions **121** for red-green reflecting regions and **113** for green-blue reflecting regions can be made using the above process of masking and changing temperatures while changing the UV wavelength to penetrate half way through layer **300**. Thus the upper portion **301** of layer **101** has a blue reflecting sub-pixel **117** and a green, blue reflecting sub-pixel **113** and a clear isotropic sub-pixel **114**. The bottom portion **302** of layer **300** is polymerized to have a red reflecting sub-pixel **127**, a red, green reflecting sub-pixel **121** and a clear sub-pixel **124**.

[0322] As shown in **FIG. 14**, the light transmitted through layer **300** will have: a red sub-pixel portion; a white reflective portion made by overlapping the red-green portion **121** with the blue portion **117** automatically forming a reflective-type intersubpixel matrix; a green sub-pixel portion; another reflective-type intersubpixel portion made by overlapping the red-green reflecting portion **121** with the green-blue reflecting portion **113** automatically forming a reflective matrix and a blue sub-pixel portion; and a third black portion made by overlapping the green blue portion **113** with the red portion **127** automatically forming a reflective-type inter-pixel matrix. Since all of these regions are realized on single layer of material, the process for making CLC-based LCD panels is simplified by having fewer layers, and fewer gluing and aligning steps to make a final display panel.

[0323] Since the penetration of the UV light is attenuated and differently at different frequencies several distinct portions providing different functions can be stacked in one layer of material.

[0324] By using the methods described above for masking and polymerizing, each sub-pixel emitting a color can also be provided with its own zero-order quarter wave plate pixel tuned to that color. Or in another embodiment, one quarter wave plate **155** can be geared for all the colors transmitted by the reflective portions of the layer. The quarter wave plate portion **155** can be polymerized by a different wavelength than the other portions of the layer and can therefore be polymerized before layer **301**.

[0325] For example, for a layer of aligned nematic mixture, which is not polymerized, a UV light with a shorter penetration length polymerizes a small depth into the layer. Exposing the film through a mask, the temperature and the exposure times are adjusted so as to polymerize only a thin nematic sub-layer (about 2 μm). The sample's temperature is set such that when the pixel is polymerized through the mask it would become a 0-order $\lambda/4$ portion of the layer for the red sub-pixel. The mask is then shifted to expose the position of the Green sub-pixels and temperature-time are adjusted to create a 0-order $\lambda/4$ portion of the layer for the green sub-pixel. The same is done for the Blue sub-pixels. The temperature is then raised to the isotropic phase and the whole sample is flooded with a longer wavelength to achieve a deeper penetration. During this step the remaining unpolymerized LC molecules, within the $\lambda/4$ portion, are polymerized into an isotropic state so that the retardation of the nematic layer will not changed by successive UV exposures. This step also creates an additional thin polymerized isotropic portion of the layer that "seals" the top $\lambda/4$ portion from the rest of the yet unpolymerized mixture below. Clearly, the top substrate must be UV transparent and have a low sticking coefficient to the polymerized portion of the layer.