PROBLEMS TO BE SOLVED BY THE INVENTION

[0007]

However, in order that a conventional four-color color filter improved in transmittance gains a brighter white color, it is necessary to use not only the chromaticity of a white auxiliary pixel, which is equal to the chromaticity of a color source, but also the chromaticity of a white color based on additive color mixture of auxiliary pixels of three colors of red, green and green. However, it is very difficult to make both the chromaticities equal to each other, namely, match both the chromaticities with each other. Thus, the color filter has the problem of being poor in white balance.

[0008]

When a line width of a black matrix is made narrow for an improvement of a color filter in aperture ratio, white spots are easily generated so that there arises a problem that color shift due to the white spots are easily generated. ~~Thus, an object~~Embodiments of the present invention ~~is to~~ provide a color filter having a high transmittance, an excellent white balance and a high aperture ratio, and causing no color shift due to white spots.

SOLUTIONS TO THE PROBLEMS

[0009]

Thus, the present inventors have made eager investigations, and as a result have found out that, for the

white balance of a four-color color filter, not the chromaticity of an additively mixed color of auxiliary pixels of three colors of red, green and blue is one-sidedly matched with the chromaticity of a white auxiliary pixel, but the chromaticity of a white auxiliary pixel is simultaneously matched with the chromaticity of an additively mixed color of auxiliary pixels of three colors of red, green and blue, namely, the white auxiliary pixel is allowed to serve as an auxiliary pixel of a fourth color, which has a specified amount of a colorant and has a specified chromaticity.

[0010]

The present inventors have further made eager investigations, and have found out that, about the shape of the color filter, while the difference in transmittance between each of the three colors of red, green and blue, and white spots is large in the red, green and blue auxiliary pixels so that color shift due to the white spots is largely affected, the difference in transmittance between the fourth color and the white spots is small in the auxiliary pixel of the fourth color so that the influence of color shift due to the white spots is small, and thus, a line width of a black matrix adjacent to the auxiliary pixel of the fourth color can be made narrow.

[0011]

~~That is,~~Embodiments of the present invention provide~~s~~ a color filter and a display device as described ~~in the following (1) to (9)~~below:

~~(1) A~~According to a first aspect, there is provided a color filter in which a black matrix is formed on a transparent substrate, a pixel including a red auxiliary pixel, a green auxiliary pixel, a blue auxiliary pixel and an auxiliary pixel of a fourth color is formed at an opening in the black matrix, or at the opening in the black matrix and on the black matrix, the line width L1 of the black matrix between the auxiliary pixel of the fourth color and each of other auxiliary pixels is from 0 to 4.5 μm, the auxiliary pixels each contain a colorant and a resin, and the tristimulus value (Y) of the auxiliary pixel of the fourth color according to the CIE 1931 color system is in the range of $70 \leq Y \leq 99$.

~~(2) The color filter according to (1), wherein~~ In an embodiment, the line width L1B of the black matrix between the auxiliary pixel of the fourth color and the blue auxiliary pixel is from 0 to 3.5 μm.

~~(3) The color filter according to (1) or (2), wherein~~ In an embodiment, a relationship between the value L1 and the broadest line width L2 of the black matrix satisfies the following: $0 \leq L1/L2 \leq 0.8$.

~~(4) The color filter according to any one of (1) to (3), wherein~~ In an embodiment, in the pixel, the width L3 of the auxiliary pixel of the fourth color on the black matrix is from 0 to 2.0 μm.

~~(5) The color filter according to any one of (1) to (4), wherein~~In an embodiment, the area of each of the auxiliary pixels of red, green, blue and the fourth color is from 240 to 3120 μm^2.

~~(6) The color filter according to any one of (1) to (5), wherein~~ In an embodiment, the concentration of the colorant in the auxiliary pixel of the

fourth color is from 0.3 to 3% by mass.

~~(7) The color filter according to any one of (1) to (6), wherein~~ In an embodiment, the film thickness of the auxiliary pixel of the fourth color is from 0.8 to 2.0 μm.

~~(8) The color filter according to any one of (1) to (7), wherein~~ In an embodiment, the tristimulus value (Y) of the auxiliary pixel of the fourth color according to the CIE 1931 color system is in the range of $75 \leq Y \leq 90$.

~~(9) A~~According to a second aspect, there is provided a display device comprising the above color filter ~~according to any one of (1) to (8)~~.

EFFECTS OF THE INVENTION

[0012]

The color filter as per embodiments of the present invention can obtain a high transmittance and a good white balance, can prevent color shift due to white spots, and can be improved in aperture ratio.

[0013]

The display device having the color filter as per embodiments of the present invention is high in both of transmittance and aperture ratio, and thus can be improved in light-use-efficiency.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Fig. 1 is a schematic view illustrating a cross section of a black matrix formed on a transparent substrate, the section being vertical to the longitudinal direction of an opening in the black matrix.