diffracting grating **115** and displaced the electroactive polymer layer **107** cooperate to emit color light, and the liquid crystal layer **120** controls gradation, thereby creating a color image.

[0039] Referring to FIG. **1**, a color reflecting unit **10** includes the electroactive polymer layer **107** and the diffraction gating **115** disposed on the electroactive polymer layer **107**. External light L is reflected by the diffraction grating **115** and emitted as color light L_c. The wavelength of the color light L_c varies depending on the pitch d of the diffraction grating **115**, and the pitch d of the diffraction grating **115** is controlled by the electroactive polymer layer **107**.

[0040] Displacement of the electroactive polymer layer **107** occurs when a voltage is applied thereto. A first electrode **106** and a second electrode **110** apply a voltage to the electroactive polymer layer **107**. Once a voltage is applied to the electroactive polymer layer **107**, a stress is applied to the electroactive polymer layer **107** due to an electric field generated between the first electrode **106** and the second electrode **110**, and thus the electroactive polymer **107** is displaced in its shape and size due to the stress. The electroactive polymer is a polymer which responds to external electrical stimulation by displaying a significant shape or size displacement. The properties and types of an electroactive polymer are disclosed in R. Pelrine, et. al., Science. 287, 836 (2000), the content of which is incorporated herein by reference. For the purpose of generating an electric field over as much area as possible, the first electrode **106** may be disposed under the electroactive polymer layer **107** and the second electrode **110** may be disposed over the electroactive polymer layer **107** such that the electroactive polymer layer **107** is sandwiched between the first electrode **106** and the second electrode **107**. Each of the first electrode **106** and the second electrode **110** may be formed of a flexible material so that they can be deformed when the electroactive polymer layer **107** is strained. The degree of displacement of the electroactive polymer layer **107** varies depending on the kind of polymer used. A relationship between strain and polymer is shown in Table 1. Table 1

TABLE 1

Circular and linear strain test results.

Material	Prestrain (x, y) (%)	Actuated relative thickness strain (%)	Actuated relative area strain (%)	Field strength (MV/m)	Effective compressive stress (MPa)	Estimated ½e (MJ/m^3)
		Circular strain				
HS3 silicone	(68, 68)	48	93	110	0.3	0.098
	(14, 14)	41	69	72	0.13	0.034
CF19-2186 silicone	(45, 45)	39	64	350	3.0	0.75
	(15, 15)	25	33	160	0.6	0.091
VHB 4910 acrylic	(300, 300)	61	158	412	7.2	3.4
	(15, 15)	29	40	55	0.13	0.022
		Linear strain				
HS3	(280, 0)	54	117	128	0.4	0.16
CF19-2186	(100, 0)	39	63	181	0.8	0.2
VHB 4910	(540, 75)	68	215	239	2.4	1.36

[0041] In order to increase the degree of displacement of an electroactive polymer, a pre-strain or pre-displacement may be applied. Upon a circular or linear pre-strain is applied, the size of the electroactive polymer is increased. FIG. **2** illustrates an electroactive polymer before and after a voltage is applied to the electroactive polymer. When a circular pre-strain is applied and then a voltage is applied, the size of the electroactive polymer is increased and thus electrodes are extended. FIG. **3** illustrates an electroactive polymer when a linear pre-strain is applied and then a voltage is applied. Referring to FIG. **3**, the size of the electroactive polymer is increased from A to B, and from C to D.

[0042] The diffraction grating **115**, which is disposed on the electroactive polymer layer **107**, is deformed according to the displacement of the electroactive polymer layer **107**. The diffraction grating **115** may be formed of a flexible material that can be deformed in accordance with the displacement of the electroactive polymer layer **107**. The diffraction grating **115** may be formed of a high reflective material, such as Al or Au, which can reflect incident light. The degree of displacement of the electroactive polymer layer **107** increases as a voltage applied to the electroactive polymer layer **107** increases. The diffraction grating **115** is extended when the displacement of the electroactive polymer layer **107** occurs. A support layer **113** may be disposed between the electroactive polymer layer **107** and the diffraction grating **115**.

[0043] When the pitch of the diffraction grating **115** when no voltage is applied to the electroactive polymer layer **107** is defined as d**0** and the pitch of the diffraction grating **115** when a voltage V is applied to the electroactive polymer layer **107** is defined as d, the pitch d of the diffraction grating **115** is defined by the formula:

$$d = \frac{d_0}{\sqrt{1 - \varepsilon\varepsilon_0 \frac{V^2}{Yt^2}}} \tag{1}$$

wherein, $\in$ denotes the dielectric constant of the diffraction grating **115**, $\in_0$ denotes the dielectric constant of air, Y denotes a Young's Modulus, and t denotes a distance between the first electrode **106** and the second electrode **110** (see FIG. **1**). Accordingly, the pitch d of the diffraction grating **115** can be controlled by changing the voltage V applied to the electroactive polymer layer **107** and the distance t between the first electrode **106** and the second electrode **110**. As the volt-