Chromatic Mirror, Chromatic Panel and Applications thereof

Description

The present application concerns chromatic mirrors and a chromatic panel.

Chromatic components are used in many applications. For example, with respect to chromatic lenses, the chromatic property is mostly a disturbing artifact. Sometimes, however, the chromatic property is a wanted property of the respective component. For example, in WO 2009156347 A1 an illumination device has been presented which uses a combination of a broadband artificial light source and a chromatic diffuser in order to illuminate, for example, indoor rooms so that the resulting scene including the interior of the room results in a more pleasant appearance in that the illumination appears to be less artificial and more natural, i.e. more similar to an illumination as it would result from an illumination in outdoor environments. The chromatic diffuser described therein simulates the Rayleigh scattering process sunlight experiences on its way down to earth.

However, it would be favorable to have other chromatic components at hand which ease the realizations of at least some application concepts, such as the one described in the just mentioned WO 2009156347 A1. For example, in use, the mentioned chromatic diffuser is capable of simulating the illumination of the sky and the sun inside an ambient. However, for this purpose a light source should be positioned beyond the diffuser, which requires the availability of a large free volume, *e.g.* several m^3, above the false ceiling, for example, if the illumination is arranged at the ceiling. Further limitations might arise from the material the diffuser is made of, in relation to mechanical resistance, fire-retardant properties, etc.

Accordingly, embodiments of the present application seek to provide such a chromatic component enabling an easier implementation of systems and concepts using such a chromatic component.

An aspect of the present invention provides a system for illumination for simulating the illumination of the sky and the sun inside an ambience, the system comprising:

a chromatic mirror comprising a mirroring surface and a diffusing layer in front of the mirroring surface, which preferentially scatters short-wavelength components of impinging light with respect to long-wavelength components of impinging light, and

an illuminator configured as a white light source to illuminate the chromatic mirror such that the impinging light passes the diffusing layer twice, once when impinging onto the mirroring surface, and once when heading away from the mirroring surface, wherein the diffusing layer comprises a transparent polymer layer having a first dispersion of light-scattering centers of average size smaller than 250nm embedded therein, thereby scattering light in a Rayleigh or Rayleigh-like regime.

The present application is based on the idea that chromatic components may alleviate the usage in various applications if this chromatic component is, according to the first aspect of

Claims

1. A system for illumination for simulating the illumination of the sky and the sun inside an ambience, the system comprising:

a chromatic mirror comprising a mirroring surface and a diffusing layer in front of the mirroring surface, which preferentially scatters short-wavelength components of impinging light with respect to long-wavelength components of impinging light, and

an illuminator (26) configured as a white light source to illuminate the chromatic mirror such that the impinging light passes the diffusing layer twice, once when impinging onto the mirroring surface, and once when heading away from the mirroring surface,

wherein the diffusing layer comprises a transparent polymer layer (14) having a first dispersion of light-scattering centers (94) of average size smaller than 250nm embedded therein, thereby scattering light in a Rayleigh or Rayleigh-like regime.

2. The system of claim 1, wherein the diffusing layer (14) is a coating or a film thinner than 100 μm deposited onto the mirroring surface (12); and/or

wherein the chromatic mirror further comprises

a transparent panel (98) and the mirroring surface and the diffusing layer are coatings or films thinner than 100 μm (100, 102) that are deposited onto the same facet or onto opposite facets of the transparent panel; and/or

a stratified-glass panel which comprises two float glass sheets (104, 106) sandwiching an adhesive transparent polymeric film, wherein the facets of the two glass sheets facing the adhesive polymeric film form in particular glass tin sides of the two glass sheets, and wherein the mirroring surface is a first coating or a film deposited onto an air side of one of the two glass sheets and wherein the diffusing layer is a second coating or a film deposited onto an air side of the other of the two glass sheets.

3. The system of any one of the preceding claims, wherein the chromatic mirror further comprises

a diffusing panel which comprises two glass sheets (104, 106) with the diffusing layer (108) sandwiched in between as an adhesive transparent polymeric film with the first dispersion of light-scattering centers of size smaller than 250nm embedded therein.

4. The system of any one of the preceding claims, wherein the mirroring surface is formed by an Al metal mirror foil and the diffusing layer is a coating or a film thinner than 100 μm deposited onto the Al metal mirror.

5. The system of any one of the preceding claims, wherein the first dispersion of light-scattering centers (94) comprises inorganic nanoparticles of diameter smaller than 250 nm embedded therein that are protected against photo-catalysis induced by near-UV and/or visible light radiation.

6. The system of claim 4 or claim 5, wherein the chromatic mirror further comprises

a protective layer made of a transparent material resistant to external atmospheric agents, and

wherein the diffusing layer is in particular sandwiched between the Al metal mirror foil (110) and the protective layer (112).

7. The system of any of the preceding claims, wherein the mirroring surface (12) is concavely, in particular concavely parabolic, shaped (12), and

wherein the mirroring surface (12) has in particular a focal length which is more than one time, in particular more than four times, smaller a square root of the mirroring surface's (12) area.

8. The system of claim 7 further comprising:

a semitransparent layer (84) positioned downstream the chromatic mirror, wherein the semitransparent layer (84) has regular transmittance in the range 5%-70%, preferably 10%-50%, more preferably 20%-40%, and, in particular, is configured to absorb less than 20% of the impinging light and/or is configured is a fabric tent.

9. The system of claim 7 or claim 8, wherein the chromatic mirror (10) is concavely shaped and the illuminator (26) is positioned at a focus plane of the chromatic mirror (10) so that the light from the illuminator (26), which is regularly reflected by the chromatic mirror (10), is parallelized.

10. The system of any one of claims 7 to 9, wherein the illuminator (26) and the chromatic mirror (10) are formed in an elongated manner along an elongation axis (x) and the chromatic mirror is concavely shaped in a plane perpendicular to the elongation axis, and

wherein the illuminator (26) has an angular and spatial luminance profile which is broad as far as a luminance profile's dependency on a first angle in a first plane perpendicular to the elongation axis is concerned, thus leading to a light beam with large angular divergence in the first plane, substantially constant as far as a luminance profile's dependency on a coordinate parallel to the elongation direction is concerned, thus leading to a spatially uniform luminance along the elongation direction, and

wherein the illuminator (26) features a narrow peak as far as a luminance profile's dependency on a second angle in a second plane perpendicular to the first plane and containing a direction of maximum luminance of the illuminator is concerned, thus leading a light beam that is substantially collimated in the second plane, and

wherein the illuminator (26) in particular comprises a sequence of pairs of a light emitter (58) and CPC reflector (60) configured to concentrate light emitted by the light emitter as far as an angular divergence of the light beam emitted by the emitter within the second plane is concerned, the pairs being sequentially arranged side by side along the elongation direction.

11. The system of any of the preceding claims, wherein the diffusing layer is placed immediately in front of the mirroring surface and is configured to not change the wanted chromatic property of the resulting chromatic component such that light regularly reflected by the chromatic mirror maintains its initial solid-angle luminance profile with merely its spectrum being affected by the wavelength-selective scattering property of the diffusing layer, and that fraction of the impinging light which passes the diffusing layer twice, namely once when impinging onto the mirroring surface, and once when heading away from the mirroring surface, maintains its luminance profile despite the interposition of the mirroring surface because the same is diffuse, or widened compared to the regularly reflected light rays, anyway.

12. The system of any of the preceding claims, wherein the chromatic mirror further comprises a second dispersion of light-scattering centers of average size exactly or greater than 5 times the average size of the light-scattering centers of the first dispersion, the second dispersion being embedded in the transparent polymer layer (14) or in a further transparent polymer layer (76), and/or

by a lateral variation of a physical and/or an optical thickness of the diffusing layer, or of a further transparent layer of the chromatic mirror (10),

such that the chromatic mirror has a reflectance at the specular angle smaller than 50% with respect to the case of comprising only the first dispersion without the layer of varying thickness and/or the second dispersion.

13. An array of systems for illumination according to any one of the preceding claims, wherein the systems for illumination are arranged and configured so that the light which is regularly reflected by the chromatic mirrors (10) forms an array of light beams oriented in the same direction.

14. An interior room (48) of a building for providing therein a sun-sky-appearance, the room (48) having a wall, a ceiling (46), and a floor and the room (48) comprising a system of any one of claims 1 to 13 for illumination for in particular simulating the illumination of the sky and the sun inside an ambient, the system in particular comprising

a chromatic mirror, and

an illuminator (26) configured as a white light source to illuminate the chromatic mirror such that the impinging light passes the diffusing layer twice,

wherein the chromatic mirror is fixed to the wall or the ceiling (46) of the room (48) and the illuminator (26) is positioned within the room (48) or in the wall, the ceiling (46) or the floor of the room (48).

15. The interior room of claim 14, wherein, during operation of the illuminator (26), illumination by way of a regularly reflected low-divergence direct light portion of the light generated by illuminator (26) and by way of diffuse, in particular bluish, light caused by the scattering within the diffusing layer of the chromatic mirror unit is achieved.

16. An architectural object comprising

a system for illumination according to any one of claims 1 to 12, and

a blocked area (90) that is blocked against human visitors entering the blocked area (90), and that is arranged so as to be lit by light using which the illuminator illuminates the chromatic mirror and which is reflected by the chromatic mirror without straying.