Claims

1. A method of achieving a tunable white light in a solid state light emitting lighting apparatus, said method comprising:

illuminating a first group of one or more solid state light emitters which emit light having a dominant wavelength in the range of from 430 nm to 485 nm;

exciting a first group of one or more lumiphors which emit light having a dominant wavelength in the range of from 555 nm to 585 nm;

illuminating a second group of one or more solid state light emitters which emit light having a dominant wavelength in the range of from 430 nm to 485 nm; and

illuminating a third group of one or more solid state light emitters which emit light having a dominant wavelength in the range of from 600 nm to 635 nm such that:

a combination of light exiting said solid state emitting lighting apparatus which was emitted by (1) said first group of solid state light emitters, (2) said first group of lumiphors, (3) said second group of solid state light emitters, and (4) said third group of solid state light emitters produces a mixture of light having x, y coordinates on a 1931 CIE Chromaticity Diagram which defines a point which is within three (3) or less MacAdam ellipses of at least one point on the Planckian locus on a 1931 CIE Chromaticity Diagram.

2. A method of achieving a tunable white light in a solid state light emitting lighting apparatus, said method comprising:

illuminating a first group of solid state light emitters, said first group includes at least one solid state light emitter, such that each solid state light emitter in said first group emits light having a dominant wavelength in the range of from 430 nm to 485 nm;

exciting a first group of one or more lumiphors which emit light having a dominant wavelength in the range of from 555 nm to 585 nm;

illuminating a second group of solid state light emitters, said second group includes at least one solid state light

emitter, such that each solid state light emitter in said second group emits light having a dominant wavelength in the range of from 430 nm to 485 nm; and

illuminating a third group of solid state light emitters, said third group includes at least one solid state light emitter, such that each solid state light emitter in said third group emits light having a dominant wavelength in the range of from 600 nm to 635 nm such that:

a combination of light exiting said solid state emitting lighting apparatus which was emitted by (1) said first group of solid state light emitters, (2) said first group of lumiphors, (3) said second group of solid state light emitters, and (4) said third group of solid state light emitters produces a mixture of light having x, y coordinates on a 1931 CIE Chromaticity Diagram which defines a point which is within three (3) or less MacAdam ellipses of at least one point on the Planckian locus on a 1931 CIE Chromaticity Diagram.

3. The method according to claim **1** or **2**, wherein if all of said first group of solid state light emitters are illuminated, at least one of the lumiphors in the first group of lumiphors is excited by light emitted by the first group of solid state light emitters.

4. The method according to claim **1** or **2**, wherein resultant white light produced by the combination of the light emitters of the first group of solid state light emitters and the respective first group of lumiphors is above the Planckian locus in the 1931 CIE chromaticity Diagram, and more than 7 MacAdam ellipses away from any point on the Planckian locus, and has a CCT between 3200K and 6000K, with a duv of >0.006.

5. The method according to claim **1** or **2**, wherein if all of said first group of solid state light emitters are illuminated, all of the lumiphors in the first group of lumiphors is excited by light emitted by the first group of solid state light emitters.

6. The method according to claim **1** or **2**, wherein said tunable white light from said solid state light emitting lighting apparatus has a CCT range of from 2700 k to 4500 k, from 2700 k to 6500 k, or between 2700 k to 6500 k.

7. The method according to claim **1** or **2**, wherein said tunable white light from said solid state light emitting lighting apparatus has a CRI of more than 85.

8. The method according to claim **1** or **2**, wherein said tunable white light from said solid state light emitting lighting apparatus has a CRI of more than 90.

9. The method according to claim **1** or **2**, wherein said tunable white light from said solid state light emitting lighting apparatus has a CCT range of from 2700K to 6500K and a CRI of more than 85.

10. The method according to claim **1** or **2**, wherein said tunable white light from said solid state light emitting lighting apparatus has a CCT range of from 2700K to 5500K and a CRI of more than 90.

11. The method according to claim **1** or **2**, wherein a combination of (1) light exiting said solid state light emitting lighting apparatus which was emitted by said first group of solid state light emitters, and (2) light exiting said solid state light emitting lighting apparatus which was emitted by said first group of lumiphors would, in the absence of additional light, produce a sub-mixture of white light which is above the Planckian locus in a 1931 CIE Chromaticity Diagram and more than seven (7) MacAdam ellipses from any point on the Planckian locus.

12. The method according to claim **1** or **2**, wherein in the step of illuminating said third group of solid state light emitters, each solid state light emitter in said third group emits light that has a dominant wavelength in the range of from 615 nm to 620 nm.

13. The method according to claim **1** or **2**, wherein in the step of illuminating said second group of solid state light emitters, each solid state light emitter in said second group emits light that has a dominant wavelength in the range of from 460 nm to 475 nm.

14. The method according to claim **1** or **2**, wherein the relative flux ratios of the first, second and third groups are controlled by a current controller such that the first group of LEDs accounts for no less than 75% of the total lumen output, the second group accounts for no more than 10% of the total lumen output, and the third group accounts for no more than 25% of the total lumen output.

15. The method according to claim **1** or **2**, further comprising adjusting the CCT of the solid state light emitting lighting apparatus by varying the driving currents of the LEDs, while maintaining a constant lumen output for any given CCT.

16. The method according to claim **1** or **2**, further comprising adjusting the CCT of the solid state light emitting lighting apparatus by varying the total lumen output of the apparatus for different CCT options.

17. A lighting apparatus comprising:

a first group of one or more solid state light emitters which emit light having a dominant wavelength in the range of from 430 nm to 485 nm;

a first group of one or more lumiphors which emit light having a dominant wavelength in the range of from 555 nm to 585 nm;

a second group of one or more solid state light emitters which emit light having a dominant wavelength in the range of from 430 nm to 485 nm; and

a third group of one or more solid state light emitters which emit light having a dominant wavelength in the range of from 600 nm to 635 nm; and

at least first, second and third power lines, said first group of solid state light emitters, said second group of solid state light emitters, and said third group of solid state light emitters each being electrically coupled to at least one of said first, second and third power lines,

wherein when current is supplied to at least one of said first, second and third power lines, a combination of light exiting said lighting apparatus which was emitted by (1) said first group of solid state light emitters, (2) said first group of lumiphors, (3) said second group of solid state light emitters, and (4) said third group of solid state light emitters produces a mixture of light having x,y coordinates on a 1931 CIE Chromaticity Diagram which defines a point which is within three (3) or less MacAdam ellipses of at least one point on the Planckian locus on a 1931 CIE Chromaticity Diagram.

18. The lighting apparatus according to claim **17**, wherein if current is supplied to a power line, a combination of (1) light exiting the lighting apparatus which was emitted by the first group of solid state light emitters, (2) light exiting the lighting apparatus which was emitted by the first group of lumiphors, (3) light exiting the lighting apparatus which was emitted by the second group of solid state light emitters, and (4) light exiting the lighting apparatus which was emitted by the third group of solid state light emitters would, in an absence of any additional light, produce light having x, y color coordinates within an area on a 1931 CIE Chromaticity Diagram defined by points having coordinates (x=0.3863, y=0.4713); (x=0.1319, y=0.0747); (x=0.6867, y=0.3132).

19. The lighting apparatus according to claim **17**, wherein said first group of solid state light emitters comprise a plurality of LEDs, said second group of solid state light emitters comprise a plurality of LEDs, and said third group of solid state light emitters comprise a plurality of LEDs.

20. The lighting apparatus according to claim **17**, wherein said lighting apparatus is tunable as to CCT level by adjusting the current levels applied to one or more of the first, second and third groups of solid state light emitters.

21. The lighting apparatus according to claim **17**, wherein said lighting apparatus is tunable to achieve a Ra>90, at CCT=2700K, 4500K and 6500K, and R13 and R15>90 on color samples corresponding to the color of human skin.

22. The lighting apparatus according to claim **17**, further comprising first, second and third current sources, corresponding to said first, second and third groups of solid state light emitters, respectively, and a controller that controls the current applied to said first, second and third groups of solid state light emitters, said controller being adapted to control the first, second and third current sources such that said lighting apparatus can achieve a Ra>90, at CCT=2700K, 4500K and 6500K, and R13 and R15>90 on color samples corresponding to the color of human skin.

23. The lighting apparatus according to claim **17**, wherein if all of said first group of solid state light emitters are illuminated, at least one of the lumiphors in the first group of lumiphors is excited by light emitted by the first group of solid state light emitters.

24. The lighting apparatus according to claim **17**, wherein resultant white light produced by the combination of the light emitters of the first group of solid state light emitters and the respective first group of lumiphors is above the Planckian locus in the 1931 CIE chromaticity Diagram, and more than 7 MacAdam ellipses away from any point on the Planckian locus, and has a CCT between 3200K and 6000K, with a duv of >0.006.

25. The apparatus according to claim **17**, wherein if all of said first group of solid state light emitters are illuminated, all of the lumiphors in the first group of lumiphors is excited by light emitted by the first group of solid state light emitters.

26. The apparatus according to claim **17**, wherein said tunable white light from said solid state light emitting lighting apparatus has a CCT range of from 2700 k to 4500 k, from 2700 k to 6500 k, or between 2700 k to 6500 k.

27. The apparatus according to claim **17**, wherein said tunable white light from said solid state light emitting lighting apparatus has a CRI of more than 85.

28. The apparatus according to claim **17**, wherein said tunable white light from said solid state light emitting lighting apparatus has a CRI of more than 90.

29. The apparatus according to claim **17**, wherein said tunable white light from said solid state light emitting lighting apparatus has a CCT range of from 2700K to 6500K and a CRI of more than 85.

30. The apparatus according to claim **17**, wherein said tunable white light from said solid state light emitting lighting apparatus has a CCT range of from 2700K to 5500K and a CRI of more than 90.

31. The apparatus according to claim **17**, wherein a combination of (1) light exiting said solid state light emitting lighting apparatus which was emitted by said first group of solid state light emitters, and (2) light exiting said solid state light emitting lighting apparatus which was emitted by said first group of lumiphors would, in the absence of additional light, produce a sub-mixture of white light which is above the Planckian locus in a 1931 CIE Chromaticity Diagram and more than seven (7) MacAdam ellipses from any point on the Planckian locus.

32. The apparatus according to claim **17**, wherein, when illuminated, each solid state light emitter in said third group emits light that has a dominant wavelength in the range of from 615 nm to 620 nm.

33. The apparatus according to claim **17**, wherein, when illuminated, each solid state light emitter in said second group emits light that has a dominant wavelength in the range of from 460 nm to 475 nm.

34. The apparatus according to claim **17**, further comprising a current controller that controls the relative flux ratios of the first, second and third groups such that the first group of LEDs accounts for no less than 75% of the total lumen output, the second group accounts for no more than 10% of the total lumen output, and the third group accounts for no more than 25% of the total lumen output.

35. The apparatus according to claim **17**, further comprising a current controller that adjusts the CCT of the solid state light emitting lighting apparatus by varying the driving currents of the LEDs, while maintaining a constant lumen output for any given CCT.

36. The apparatus according to claim **17**, further comprising a current controller that adjusts the CCT of the solid state light emitting lighting apparatus by adjusting the total lumen output of the apparatus for different CCT options.

37. The lighting apparatus according to claim **17**, wherein said lighting apparatus is tunable to achieve a Ra>90, at CCT in a range of 2700K~6500K, and R13 and R15>90 on color samples corresponding to the color of human skin.

38. The lighting apparatus according to claim **17**, further comprising first, second and third current sources, corresponding to said first, second and third groups of solid state light emitters, respectively, and a controller that controls the current applied to said first, second and third groups of solid state light emitters, said controller being adapted to control the first, second and third current sources such that said lighting apparatus can achieve a Ra>90, at CCT in a range of 2700K~6500K, and R13 and R15>90 on color samples corresponding to the color of human skin.

39. The apparatus according to claim **17**, further comprising a current controller that controls the relative flux ratios of the first, second and third groups, the controller having a look-up table associated therewith, the controller being programmed to:

accept commands from a user, including a command to set a CCT and a total flux output in response to receipt of the command,

retrieve a set of data that contains information of the required flux output of each group of LEDs from the look-up table, and

based on the 100% duty cycle (full power) flux output of each group, generate pulse width modulation (PWM) signals to control current supplied to each group to alter the flux output of each group in order to achieve a desired CCT and total flux output.

40. The apparatus according to claim **39**, further comprising first, second and third current sources, corresponding to said first, second and third groups, respectively, the controller controlling the current supplied to each group via said first, second and third current sources.

41. The apparatus according to claim **40**, said first, second and third current sources each having a temperature sensor to sense the temperature of groups, respectively, wherein currents supplied by the current sources are adjusted by the temperature sensors to compensate the flux variation due to temperature changes, allowing the 100% duty cycle flux output of each group of LEDs to be maintained irrespective of temperature changes.

42. A lighting apparatus comprising:

a first group of solid state light emitters;

a first group of lumiphors;

a second group of solid state light emitters;

a third group of solid state light emitters; and

at least first, second and third power lines, said first group of solid state light emitters, said second group of solid

state light emitters, and said third group of solid state light emitters each being electrically coupled to at least one of said first, second and third power lines,

wherein said first group of solid state light emitters includes at least one solid state light emitter, such that each solid state light emitter in said first group, if illuminated, emits light having a dominant wavelength in the range of from 430 nm to 485 nm; said first group of lumiphors includes at least one lumiphor, such that each lumiphor in said first group, when excited, emits light having a dominant wavelength in the range of from 555 nm to 585 nm; said second group of solid state light emitters includes at least one solid state light emitter, such that each solid state light emitter in said second group, if illuminated, emits light having a dominant wavelength in the range of from 430 nm to 485 nm; and said third group of solid state light emitters includes at least one solid state light emitter, such that each solid state light emitter in said third group, if illuminated, emits light having a dominant wavelength in the range of from 600 nm to 635 nm; if current is supplied to at least one of said first, second and third power lines, a combination of light exiting said solid state emitting lighting apparatus which was emitted by (1) said first group of solid state light emitters, (2) said first group of lumiphors, (3) said second group of solid state light emitters, and (4) said third group of solid state light emitters produces a mixture of light having x,y coordinates on a 1931 CIE Chromaticity Diagram which defines a point which is within three (3) or less MacAdam ellipses of at least one point on the Planckian locus on a 1931 CIE Chromaticity Diagram.

43. A lighting apparatus comprising:
a first group of solid state light emitters;
a first group of lumiphors;
a second group of solid state light emitters;
a third group of solid state light emitters;
at least first, second and third power lines, said first group of solid state light emitters, said second group of solid state light emitters, and said third group of solid state light emitters each being electrically coupled to at least one of said first, second and third power lines; and
a current controller that controls the relative flux ratios of the first, second and third groups, the controller having a look-up table associated therewith, the controller being programmed to:
accept commands from a user, including a command to set a CCT and a total flux output in response to receipt of the command,
retrieve a set of data that contains information of the required flux output of each group of LEDs from the look-up table, and
based on the 100% duty cycle (full power) flux output of each group, generate pulse width modulation (PWM) signals to control current supplied to each group to alter the flux output of each group in order to achieve a desired CCT and total flux output.

44. The lighting apparatus according to claim **43**, further comprising first, second and third current sources, corresponding to said first, second and third groups, respectively, the controller controlling the current supplied to each group via said first, second and third current sources.

45. A method on a solid state lighting apparatus comprising: a first group of solid state light emitters; a first group of lumiphors; a second group of solid state light emitters; a third group of solid state light emitters; at least first, second and third power lines, said first group of solid state light emitters, said second group of solid state light emitters, and said third group of solid state light emitters each being electrically

coupled to at least one of said first, second and third power lines; and a current controller that controls the relative flux ratios of the first, second and third groups, the controller having a look-up table associated therewith, the method comprising the controller:

accepting commands from a user, including a command to set a CCT and a total flux output in response to receipt of the command,

retrieving a set of data that contains information of the required flux output of each group of LEDs from the look-up table, and

based on the 100% duty cycle (full power) flux output of each group, generating pulse width modulation (PWM) signals to control current supplied to each group to alter the flux output of each group in order to achieve a desired CCT and total flux output.

46. A lighting apparatus comprising:

first, second and third groups of solid state light emitters;

a first group of lumiphors;

at least first, second and third power lines, the first, second and third group of solid state light emitters each being electrically coupled to at least one of the first, second and third power lines;

a current controller that controls the relative flux ratios of the first, second and third groups, the controller being programmed to, in response to receipt of a command, retrieve a set of data from a look-up table that contains information of the required flux output of each group of LEDs and generate pulse width modulation (PWM) signals to control current supplied to each group to alter the flux output of each group in order to achieve a desired CCT and total flux output.

CLAIMS

What is claimed is:

1. A method of achieving a tunable white light in a solid state light emitting lighting apparatus, said method comprising:

illuminating a first group of one or more solid state light emitters which emit light having a dominant wavelength in the range of from 430 nm to 485 nm;

exciting a first group of one or more lumiphors which emit light having a dominant wavelength in the range of from 555 nm to 585 nm;

illuminating a second group of one or more solid state light emitters which emit light having a dominant wavelength in the range of from 430 nm to 485 nm; and

illuminating a third group of one or more solid state light emitters which emit light having a dominant wavelength in the range of from 600 nm to 635 nm such that:

a combination of light exiting said solid state emitting lighting apparatus which was emitted by (1) said first group of solid state light emitters, (2) said first group of lumiphors, (3) said second group of solid state light emitters, and (4) said third group of solid state light emitters produces a mixture of light having x, y coordinates on a 1931 CIE Chromaticity Diagram which defines a point which is within three (3) or less MacAdam ellipses of at least one point on the Planckian locus on a 1931 CIE Chromaticity Diagram.

2. A method of achieving a tunable white light in a solid state light emitting lighting apparatus, said method comprising:

illuminating a first group of solid state light emitters, said first group includes at least one solid state light emitter, such that each solid state light emitter in said first group emits light having a dominant wavelength in the range of from 430 nm to 485 nm;

exciting a first group of one or more lumiphors which emit light having a dominant wavelength in the range of from 555 nm to 585 nm;

illuminating a second group of solid state light emitters, said second group includes at least one solid state light emitter, such that each solid state light emitter in said second group emits light having a dominant wavelength in the range of from 430 nm to 485 nm; and

illuminating a third group of solid state light emitters, said third group includes at least one solid state light emitter, such that each solid state light emitter in said third group emits light having a dominant wavelength in the range of from 600 nm to 635 nm such that:

a combination of light exiting said solid state emitting lighting apparatus which was emitted by (1) said first group of solid state light emitters, (2) said first group of lumiphors, (3) said second group of solid state light emitters, and (4) said third group of solid state light emitters produces a mixture of light having x, y coordinates on a 1931 CIE Chromaticity Diagram which defines a point which is within three (3) or less MacAdam ellipses of at least one point on the Planckian locus on a 1931 CIE Chromaticity Diagram.

3. The method according to claim 1 or 2, wherein if all of said first group of solid state light emitters are illuminated, at least one of the lumiphors in the first group of lumiphors is excited by light emitted by the first group of solid state light emitters.

4. The method according to any one of claims 1-3, wherein resultant white light produced by the combination of the light emitters of the first group of solid state light emitters and the respective first group of lumiphors is above the Planckian locus in the 1931 CIE chromaticity Diagram, and more than 7 MacAdam ellipses away from any point on the Planckian locus, and has a CCT between 3200K and 6000K, with a duv of > 0.006.

5. The method according to any one of claims 1-4, wherein if all of said first group of solid state light emitters are illuminated, all of the lumiphors in the first group of lumiphors is excited by light emitted by the first group of solid state light emitters.

6. The method according to any one of claims 1-5, wherein said tunable white light from said solid state light emitting lighting apparatus has a CCT range of from 2700k to 4500k, from 2700k to 6500k, or between 2700k to 6500k.

7. The method according to any one of claims 1-6, wherein said tunable white light from said solid state light emitting lighting apparatus has a CRI of more than 85.

8. The method according to any one of claims 1-6, wherein said tunable white light from said solid state light emitting lighting apparatus has a CRI of more than 90.

9. The method according to any one of claims 1-5, wherein said tunable white light from said solid state light emitting lighting apparatus has a CCT range of from 2700K to 6500K and a CRI of more than 85.

10. The method according to any one of claims 1-5, wherein said tunable white light from said solid state light emitting lighting apparatus has a CCT range of from 2700K to 5500K and a CRI of more than 90.

11. The method according to claim 1 or 2, wherein a combination of (1) light exiting said solid state light emitting lighting apparatus which was emitted by said first group of solid state light emitters, and (2) light exiting said solid state light

emitting lighting apparatus which was emitted by said first group of lumiphors would, in the absence of additional light, produce a sub-mixture of white light which is above the Planckian locus in a 1931 CIE Chromaticity Diagram and more than seven (7) MacAdam ellipses from any point on the Planckian locus.

12. The method according to claim 1 or 2, wherein in the step of illuminating said third group of solid state light emitters, each solid state light emitter in said third group emits light that has a dominant wavelength in the range of from 615nm to 620nm.

13. The method according to claim 1 or 2, wherein in the step of illuminating said second group of solid state light emitters, each solid state light emitter in said second group emits light that has a dominant wavelength in the range of from 460nm to 475nm.

14. The method according to claim 1 or 2, wherein the relative flux ratios of the first, second and third groups are controlled by a current controller such that the first group of LEDs accounts for no less than 75% of the total lumen output, the second group accounts for no more than 10% of the total lumen output, and the third group accounts for no more than 25% of the total lumen output.

15. The method according to claim 1 or 2, further comprising adjusting the CCT of the solid state light emitting lighting apparatus by varying the driving currents of the LEDs, while maintaining a constant lumen output for any given CCT.

16. The method according to claim 1 or 2, further comprising adjusting the CCT of the solid state light emitting lighting apparatus by varying the total lumen output of the apparatus for different CCT options.

17. A lighting apparatus comprising:

a first group of one or more solid state light emitters which emit light having a dominant wavelength in the range of from 430 nm to 485 nm;

a first group of one or more lumiphors which emit light having a dominant wavelength in the range of from 555 nm to 585 nm;

a second group of one or more solid state light emitters which emit light having a dominant wavelength in the range of from 430 nm to 485 nm; and

a third group of one or more solid state light emitters which emit light having a dominant wavelength in the range of from 600 nm to 635 nm; and

at least first, second and third power lines, said first group of solid state light emitters, said second group of solid state light emitters, and said third group of solid state light emitters each being electrically coupled to at least one of said first, second and third power lines,

wherein when current is supplied to at least one of said first, second and third power lines, a combination of light exiting said lighting apparatus which was emitted by (1) said first group of solid state light emitters, (2) said first group of lumiphors, (3) said second group of solid state light emitters, and (4) said third group of solid state light emitters produces a mixture of light having x,y coordinates on a 1931 CIE Chromaticity Diagram which defines a point which is within three (3) or less MacAdam ellipses of at least one point on the Planckian locus on a 1931 CIE Chromaticity Diagram.

18. A lighting apparatus comprising:

a first group of solid state light emitters;

a first group of lumiphors;

a second group of solid state light emitters;

a third group of solid state light emitters; and

at least first, second and third power lines, said first group of solid state light emitters, said second group of solid state light emitters, and said third group of solid state light emitters each being electrically coupled to at least one of said first, second and third power lines,

wherein said first group of solid state light emitters includes at least one solid state light emitter, such that each solid state light emitter in said first group, if illuminated, emits light having a dominant wavelength in the range of from 430 nm to 485 nm; said first group of lumiphors includes at least one lumiphor, such that each lumiphor in said first group, when excited, emits light having a dominant wavelength in the range of from 555 nm to 585 nm; said second group of solid state light emitters includes at least one solid state light emitter, such that each solid state light emitter in said second group, if illuminated, emits light having a dominant wavelength in the range of from 430 nm to 485 nm; and said third group of solid state light emitters includes at least one solid state light emitter, such that each solid state light emitter in said third group, if illuminated, emits light having a dominant wavelength in the range of from 600 nm to 635 nm; if current is supplied to at least one of said first, second and third power lines, a combination of light exiting said solid state emitting lighting apparatus which was emitted by (1) said first group of solid state light emitters, (2) said first group of lumiphors, (3) said second group of solid state light emitters, and (4) said third group of solid state light emitters produces a mixture of light having x,y coordinates on a 1931 CIE Chromaticity Diagram which defines a point which is within three (3) or less MacAdam ellipses of at least one point on the Planckian locus on a 1931 CIE Chromaticity Diagram.

19. The lighting apparatus according to claim 17 or 18, wherein if current is supplied to a power line, a combination of (1) light exiting the lighting apparatus which was emitted by the first group of solid state light emitters, (2) light exiting the lighting apparatus which was emitted by the first group of lumiphors, (3) light

exiting the lighting apparatus which was emitted by the second group of solid state light emitters, and (4) light exiting the lighting apparatus which was emitted by the third group of solid state light emitters would, in an absence of any additional light, produce light having x, y color coordinates within an area on a 1931 CIE Chromaticity Diagram defined by points having coordinates (x = 0.3863, y = 0.4713); (x = 0.1319, y = 0.0747); (x = 0.6867, y = 0.3132).

20. The lighting apparatus according to claim 17 or 18, wherein said first group of solid state light emitters comprise a plurality of LEDs, said second group of solid state light emitters comprise a plurality of LEDs, and said third group of solid state light emitters comprise a plurality of LEDs.

21. The lighting apparatus according to claim 17 or 18, wherein said lighting apparatus is tunable as to CCT level by adjusting the current levels applied to one or more of the first, second and third groups of solid state light emitters.

22. The lighting apparatus according to claim 17 or 18, wherein said lighting apparatus is tunable to achieve a Ra > 90, at CCT = 2700K, 4500K and 6500K, and R13 and R15 > 90 on color samples corresponding to the color of human skin.

23. The lighting apparatus according to claim 17 or 18, further comprising first, second and third current sources, corresponding to said first, second and third groups of solid state light emitters, respectively, and a controller that controls the current applied to said first, second and third groups of solid state light emitters, said controller being adapted to control the first, second and third current sources such that said lighting apparatus can achieve a Ra > 90, at CCT = 2700K, 4500K and 6500K, and R13 and R15 > 90 on color samples corresponding to the color of human skin.

24. The lighting apparatus according to claim 17 or 18, wherein if all of said first group of solid state light emitters are illuminated, at least one of the lumiphors in the first group of lumiphors is excited by light emitted by the first group of solid state light emitters.

25. The lighting apparatus according to any one of claims 17-24, wherein resultant white light produced by the combination of the light emitters of the first group of solid state light emitters and the respective first group of lumiphors is above the Planckian locus in the 1931 CIE chromaticity Diagram, and more than 7 MacAdam ellipses away from any point on the Planckian locus, and has a CCT between 3200K and 6000K, with a duv of > 0.006.

26. The apparatus according to any one of claims 17-25, wherein if all of said first group of solid state light emitters are illuminated, all of the lumiphors in the first group of lumiphors is excited by light emitted by the first group of solid state light emitters.

27. The apparatus according to any one of claims 17-26, wherein said tunable white light from said solid state light emitting lighting apparatus has a CCT range of from 2700k to 4500k, from 2700k to 6500k, or between 2700k to 6500k.

28. The apparatus according to any one of claims 17-27, wherein said tunable white light from said solid state light emitting lighting apparatus has a CRI of more than 85.

29. The apparatus according to any one of claims 17-27, wherein said tunable white light from said solid state light emitting lighting apparatus has a CRI of more than 90.

30. The apparatus according to any one of claims 17-27, wherein said tunable white light from said solid state light emitting lighting apparatus has a CCT range of from 2700K to 6500K and a CRI of more than 85.

31. The apparatus according to any one of claims 17-27, wherein said tunable white light from said solid state light emitting lighting apparatus has a CCT range of from 2700K to 5500K and a CRI of more than 90.

32. The apparatus according to claims 17-27, wherein a combination of (1) light exiting said solid state light emitting lighting apparatus which was emitted by said first group of solid state light emitters, and (2) light exiting said solid state light emitting lighting apparatus which was emitted by said first group of lumiphors would, in the absence of additional light, produce a sub-mixture of white light which is above the Planckian locus in a 1931 CIE Chromaticity Diagram and more than seven (7) MacAdam ellipses from any point on the Planckian locus.

33. The apparatus according to claim 17 or 18, wherein, when illuminated, each solid state light emitter in said third group emits light that has a dominant wavelength in the range of from 615nm to 620nm

34. The apparatus according to claim 17 or 18, wherein, when illuminated, each solid state light emitter in said second group emits light that has a dominant wavelength in the range of from 460nm to 475nm.

35. The apparatus according to claim 17 or 18, further comprising a current controller that controls the relative flux ratios of the first, second and third groups such that the first group of LEDs accounts for no less than 75% of the total lumen

output, the second group accounts for no more than 10% of the total lumen output, and the third group accounts for no more than 25% of the total lumen output.

36. The apparatus according to claim 17 or 18, further comprising a current controller that adjusts the CCT of the solid state light emitting lighting apparatus by varying the driving currents of the LEDs, while maintaining a constant lumen output for any given CCT.

37. The apparatus according to claim 17 or 18, further comprising a current controller that adjusts the CCT of the solid state light emitting lighting apparatus by adjusting the total lumen output of the apparatus for different CCT options.

38. The lighting apparatus according to claim 17 or 18, wherein said lighting apparatus is tunable to achieve a Ra > 90, at CCT in a range of 2700K~6500K, and R13 and R15 > 90 on color samples corresponding to the color of human skin.

39. The lighting apparatus according to claim 17 or 18, further comprising first, second and third current sources, corresponding to said first, second and third groups of solid state light emitters, respectively, and a controller that controls the current applied to said first, second and third groups of solid state light emitters, said controller being adapted to control the first, second and third current sources such that said lighting apparatus can achieve a Ra > 90, at CCT in a range of 2700K~6500K, and R13 and R15 > 90 on color samples corresponding to the color of human skin.

40. The apparatus according to claim 17 or 18, further comprising a current controller that controls the relative flux ratios of the first, second and third groups, the controller having a look-up table associated therewith, the controller being programmed to:

accept commands from a user, including a command to set a CCT and a total flux output in response to receipt of the command,

retrieve a set of data that contains information of the required flux output of each group of LEDs from the look-up table, and

based on the 100% duty cycle (full power) flux output of each group, generate pulse width modulation (PWM) signals to control current supplied to each group to alter the flux output of each group in order to achieve a desired CCT and total flux output.

41. The apparatus according to claim 40, further comprising first, second and third current sources, corresponding to said first, second and third groups, respectively, the controller controlling the current supplied to each group via said first, second and third current sources.

42. The apparatus according to claim 41, said first, second and third current sources each having a temperature sensor to sense the temperature of groups, respectively, wherein currents supplied by the current sources are adjusted by the temperature sensors to compensate the flux variation due to temperature changes, allowing the 100% duty cycle flux output of each group of LEDs to be maintained irrespective of temperature changes.

43. A lighting apparatus comprising:

a first group of solid state light emitters;

a first group of lumiphors;

a second group of solid state light emitters;

a third group of solid state light emitters;

at least first, second and third power lines, said first group of solid state light emitters, said second group of solid state light emitters, and said third group of

solid state light emitters each being electrically coupled to at least one of said first, second and third power lines; and

a current controller that controls the relative flux ratios of the first, second and third groups, the controller having a look-up table associated therewith, the controller being programmed to:

accept commands from a user, including a command to set a CCT and a total flux output in response to receipt of the command,

retrieve a set of data that contains information of the required flux output of each group of LEDs from the look-up table, and

based on the 100% duty cycle (full power) flux output of each group, generate pulse width modulation (PWM) signals to control current supplied to each group to alter the flux output of each group in order to achieve a desired CCT and total flux output.

44. The lighting apparatus according to claim 43, further comprising first, second and third current sources, corresponding to said first, second and third groups, respectively, the controller controlling the current supplied to each group via said first, second and third current sources.

45. A method on a solid state lighting apparatus comprising: a first group of solid state light emitters; a first group of lumiphors; a second group of solid state light emitters; a third group of solid state light emitters; at least first, second and third power lines, said first group of solid state light emitters, said second group of solid state light emitters, and said third group of solid state light emitters each being electrically coupled to at least one of said first, second and third power lines; and a current controller that controls the relative flux ratios of the first, second and third groups, the controller having a look-up table associated therewith, the method comprising the controller:

accepting commands from a user, including a command to set a CCT and a total flux output in response to receipt of the command,

retrieving a set of data that contains information of the required flux output of each group of LEDs from the look-up table, and

based on the 100% duty cycle (full power) flux output of each group, generating pulse width modulation (PWM) signals to control current supplied to each group to alter the flux output of each group in order to achieve a desired CCT and total flux output.

46. A lighting apparatus comprising:

first, second and third groups of solid state light emitters;

a first group of lumiphors;

at least first, second and third power lines, the first, second and third group of solid state light emitters each being electrically coupled to at least one of the first, second and third power lines;

a current controller that controls the relative flux ratios of the first, second and third groups, the controller being programmed to, in response to receipt of a command, retrieve a set of data from a look-up table that contains information of the required flux output of each group of LEDs and generate pulse width modulation (PWM) signals to control current supplied to each group to alter the flux output of each group in order to achieve a desired CCT and total flux output.