attempts to increase light intensity of the lighting source often lead to unstable performance due to heat accumulation for high power lighting sources.

Accordingly, there is a need to provide a lighting system and an additive manufacturing system for three-dimensional printing which are able to overcome or at least ameliorate the disadvantages discussed above.

Summary

There is provided a lighting system comprising

a light source, and

a cooling system with temperature sensing and responding capability coupled to the light source for maintaining a temperature of the light source within a defined variation from a set temperature.

In one aspect, there is provided a lighting system for three-dimensional printing comprising

a light source having a power rating in a range of about 30 watt to about 80 watt, and

an integrated cooling system with temperature sensing and responding capability coupled to the light source for maintaining a temperature of the light source within a defined variation from a set temperature, wherein the integrated cooling system is configured to detect the temperature variation of the light source and is programmed to respond to the temperature variation to adjust the temperature of the light source back to the set temperature.

Advantageously, the cooling system may be used to stabilize the temperature of the light source in a self-feedback manner. The cooling system may sense and respond to the temperature change of the light source to maintain the temperature of the light source at around a substantially stable temperature or a set temperature with some allowable deviation from the set temperature.

Further advantageously, the lighting source can operate at a high power range without leading to an unstable performance due to the heat accumulation of the high light intensity of the light source.

There is also provided a method of adjusting a temperature of a light source comprising the steps of

a) sensing the temperature of the light source, and

b) adjusting the operation of a cooling means of a cooling system with temperature sensing and responding capability coupled to the light source in response to a temperature change of the light source, whereby the temperature change is a temperature difference between the temperature sensed in step (a) and a set temperature of the light source.

In another aspect, there is provided a method of adjusting a temperature of a light source as defined herein comprising the steps of

a) sensing the temperature of the light source, and

b) adjusting an operation of a cooling means of an integrated cooling system with temperature sensing and responding capability coupled to the light source in response to a temperature change of the light source, whereby the temperature change is a temperature difference between the temperature sensed in step (a) and a set temperature of the light source.

The method of adjusting the temperature of the light source may be regarded as a method of cooling the light source, whereby the temperature of the light source is decreased by increasing the operation of the cooling means when the temperature of the light source is above the set temperature, resulting in a temperature change between the temperature sensed in step (a), and the set temperature. Therefore, the cooling means is operated when the temperature of the light source in step (a) is above the set temperature of the light source by more than a pre-determined variation (which can be a discrete value or a percentage value). The sensing step (a) can also be regarded as a measuring step (a) in which the temperature of the light source is measured.

There is also provided a method of assembling the lighting system as defined herein, comprising the steps of

a) attaching a light source to a heat sink with a thermally conductive adhesive, and

b) coupling a cooling system with temperature sensing and responding capability to the light source, the heat sink, or the thermally conductive adhesive.

In another aspect, there is provided a method of assembling the lighting system as defined herein, comprising the steps of

a) attaching a light source to a heat sink with a thermally conductive adhesive, and

b) coupling an integrated cooling system with temperature sensing and responding capability to the light source, the heat sink, or the thermally conductive adhesive.

Claims

1. A lighting system for three-dimensional printing comprising

a light source having a power rating in a range of about 30 watt to about 80 watt, and

an integrated cooling system with temperature sensing and responding capability coupled to the light source for maintaining a temperature of the light source within a defined variation from a set temperature, wherein the integrated cooling system is configured to detect the temperature variation of the light source and is programmed to respond to the temperature variation to adjust the temperature of the light source back to the set temperature.

2. The light system of claim 1, wherein the light source is a light emitting diode (LED) array.

3. The light system of any one of the preceding claims, further comprising a heat sink coupled to the light source.

4. The light system of claim 3, further comprising a thermally conductive adhesive which fills a gap between the light source and the heat sink.

5. The light system of any one of the preceding claims, wherein the integrated cooling system comprises:

a temperature sensor;

a controlling board configured to generate a command signal responsive to the temperature sensor; and

a cooling means configured to cool the light source in response to the command signal.

6. The light system of claim 5, wherein the temperature sensor is coupled to the light source.

7. The light system of any one of claims 3 to 6, wherein the light source and the temperature sensor are disposed on the heat sink and the temperature sensor detects the temperature of the heat sink.

8. The light system of any one of claims 5 to 7, wherein the cooling means is an electronic fan.

9. A method of adjusting a temperature of a light source as defined in any one of the preceding claims comprising the steps of

a) sensing the temperature of the light source, and

b) adjusting an operation of a cooling means of an integrated cooling system with temperature sensing and responding capability coupled to the light source in response to a temperature change of the light source, whereby the temperature change is a temperature difference between the temperature sensed in step (a) and a set temperature of the light source.

10. The method of claim 9, wherein the set temperature is in a range of about 20^{o}C to about 40^{o}C.

11. The method of claim 9 or 10, wherein step b) comprises the step of b1) operating the cooling means at a default cooling rate when the light source is turned on.

12. The method of claim 11, wherein step b) further comprises the step of b2) increasing the operation of the cooling means by a defined percentage for each degree Celsius temperature increase of the light source above the set temperature.

13. The method of claim 12, wherein the defined percentage is in the range of about 5% to about 30%.

14. The method of claim 12 or 13, wherein step b) further comprises the step of operating the cooling means at the default cooling rate or stopping the cooling means if the temperature of the light source is lower than the set temperature.

15. The method of any one of claims 11 to 14, wherein the default cooling rate is in the range about 50 rpm to about 200 rpm.

16. A method of assembling the lighting system of any one of claims 1 to 8, comprising the steps of

a) attaching a light source to a heat sink with a thermally conductive adhesive, and

b) coupling an integrated cooling system with temperature sensing and responding capability to the light source, the heat sink, or the thermally conductive adhesive.

17. The method of claim 16, wherein the integrated cooling system is coupled to the light source, the heat sink, or the thermally conductive adhesive via a temperature sensor.

18. The method of claim 17, wherein the temperature sensor is further coupled to a controlling board and the controlling board is coupled to a cooling means responsive to a command signal generated by the controlling board.

19. An additive manufacturing system for three-dimensional printing comprising the lighting system of any one of claims 1 to 8.