board), there is no cavity and the procedure has to be different. To provide for an encapsulation having a specific geometric shape, an encapsulation mold having the desired geometric shape is separately designed and manufactured. The mold is then mounted onto the substrate so that it fits around the LED chip. The mold is then filled with the phosphor mixture or other encapsulation material.

[0005] Unfortunately, using a separately designed and manufactured mold is costly, time consuming, and requires additional manufacturing operations. For example, the mold needs to be designed and fabricated as a separate part, which is time consuming and costly. The mold then needs to be mounted onto the substrate before it can be filled with the encapsulation material, which requires additional manufacturing operations.

[0006] Accordingly, there is a need in the art for improvements in encapsulation technology so that encapsulations having a variety of shapes can be formed quickly and flexibility to reduce costs and simplify the manufacture of LED devices.

SUMMARY

[0007] In various aspects, a phosphor deposition system is provided that allows LED encapsulations having a variety of geometries to be formed in a fast, flexible, and cost effective manner with simple manufacturing operations.

[0008] According to a first aspect, there is provided a method for forming an encapsulation, the method comprising: applying a transparent dam material onto a substrate to form a boundary defining a region, wherein the transparent dam material is configured to refract light to provide a broader emitted light pattern than would a reflective dam material; and filling the region with encapsulation material.~~In an aspect, a method is provided for forming an encapsulation. The method comprises determining a geometric shape for the encapsulation, selecting a dam material, applying the dam material to a substrate to form a boundary defining a region having the geometric shape, and filling the region with encapsulation material to form the encapsulation.~~

[0009] According to a second aspect, there is provided a light emitting diode (LED) apparatus comprising: at least one LED chip; and an encapsulation disposed on the at least one LED chip, wherein the encapsulation is formed by: applying a transparent dam material onto a substrate to form a boundary defining a region, wherein the transparent dam material is configured to refract light to provide a broader emitted light pattern than would a reflective dam material; and filling the region with encapsulation material. ~~In another aspect, an LED apparatus is provided that comprises at least one LED chip and an encapsulation disposed on the at least one LED chip. The encapsulation is formed by determining a geometric shape for the encapsulation, selecting a dam material, applying the dam material to a substrate to form a boundary defining a region having the geometric shape, and filling the region with encapsulation material to form the encapsulation.~~

[0010] According to a third aspect, there is provided a light emitting diode (LED) lamp comprising: a package; a light emitting diode apparatus coupled to the package and comprising: at least one LED chip and an encapsulation disposed on the at least one LED chip, wherein the encapsulation is formed by: applying a transparent dam material to a substrate to form a boundary defining a region, wherein the dam material is configured to refract light to provide a broader emitted light pattern than would a reflective dam material; and filling the region with encapsulation material. ~~In another aspect, an LED lamp is provided that comprises a package and an LED apparatus coupled to the package. The LED apparatus comprises at~~

~~least one LED chip and an encapsulation disposed on the at least one LED chip. The encapsulation is formed by determining a geometric shape for the encapsulation, selecting a dam material, applying the dam material to a substrate to form a boundary defining a region having the geometric shape, and filling the region with encapsulation material to form the encapsulation~~

[0011] It is understood that other ~~aspects~~embodiments of the present invention will become readily apparent to those skilled in the art from the following detailed description. As will be realized, the present invention includes other and different ~~aspects~~embodiments and its several details are capable of modification in various other respects, all without departing from the spirit and scope of the present invention. Accordingly, the drawings and the detailed description are to be regarded as illustrative in nature and not as restrictive.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The foregoing aspects described herein will become more readily apparent by reference to the following Description when taken in conjunction with the accompanying drawings wherein:

[0013] **FIG. 1** shows an exemplary LED assembly that illustrates aspects of a phosphor deposition system;

[0014] **FIG. 2** shows an exemplary LED assembly that illustrates aspects of a phosphor deposition system;

[0015] **FIG. 3** shows an exemplary method for providing encapsulations in accordance with a phosphor deposition system; and

[0016] **FIG. 4** shows exemplary devices comprising LED assemblies constructed in accordance with a phosphor deposition system.

DESCRIPTION

[0017] The present invention is described more fully hereinafter with reference to the accompanying drawings, in which various aspects of the present invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the various aspects of the present invention presented throughout this disclosure. Rather, these aspects are