

WHAT IS CLAIMED IS:

1. A quantum-dot (QD) light-emitting diode (QLED) device comprising:
an active emission region, said active emission region comprising n QD layers interleaved with $(n - 1)$ quantum-barrier (QB) layers where n is a positive integer greater than one, such that each QB layer is sandwiched between two adjacent QD layers.
2. The QLED device of claim 1, wherein each QD layer comprises Cadmium Selenide/Zinc Sulfide (CdSe/ZnS).
3. The QLED device of claim 1 or 2, wherein each QB layer comprises Poly(methyl methacrylate) (PMMA).
4. The QLED device of any one of claims 1 to 3, wherein $n = 3$.
5. The QLED device of any one of claims 1 to 3, wherein $n = 5$.
6. The QLED device of any one of claims 1 to 3, wherein $2 \leq n \leq 6$.
7. The QLED device of any one of claims 1 to 6, wherein the thickness of each QD layer is about eight times of that of each QB layer.
8. The QLED device of any one of claims 1 to 6, wherein the thickness of each QD layer is about 15 nm to 35 nm, and wherein the thickness of each QB layer is about 1 nm to 5 nm.
9. The QLED device of any one of claims 1 to 6, wherein the thickness of each QD layer is about 15 nm to 35 nm, and wherein the thickness of each QB layer is about 2 nm to 4 nm.
10. The QLED device of any one of claims 1 to 9 further comprising:
an electron-transport layer (ETL); and
a hole-injection layer (HIL);
wherein said ETL and HIL sandwich the active emission region therebetween.
11. The QLED device of claim 10, wherein the ETL comprises synthesized ZnO nanocrystals, and the HIL comprises poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT:PSS).

12. The QLED device of claim 10 or 11 further comprising:
a hole-transport layer (HTL) sandwiched between the active emission region and the HIL.
13. The QLED device of claim 12, wherein the HTL comprises poly(9-vinylcarbazole) (PVK).
14. The QLED device of any one of claims 11 to 13 further comprising:
a cathode layer coupled to the ETL;
an anode layer coupled to the HIL; and
a transparent substrate coupled to the anode layer.
15. The QLED device of claim 14, wherein the cathode layer comprises silver, and the anode layer is a transparent layer comprising Indium Tin Oxide (ITO).
16. The QLED device of any one of claims 1 to 15, wherein each QB layer has a conductive band higher than that each QD layer.
17. The QLED device of claim 16, wherein the energy at the valence band of each QB layer is higher than the energy at the valence band of each QD layer.
18. The QLED device of claim 1 or 2, wherein each QB layer comprises PVK, 4,4'-Cyclohexylidenebis[N,N-bis(4-methylphenyl)benzenamine] (TAPC), or Poly[N,N'-bis(4-butylphenyl)-N,N'-bisphenylbenzidine] (Poly-TPD).
19. A quantum-dot light-emitting diode (QLED) device comprising a plurality of layers sequentially coupled together, the plurality of layers comprising, from a first side to a second side thereof:
a cathode layer;
an electron-transport layer (ETL);
an active emission region;
a hole-injection layer (HIL); and
an anode layer;
wherein the active emission region comprises n quantum-dot (QD) layers interleaved with $(n - 1)$ quantum-barrier (QB) layers where n is a positive integer greater than one, such that each QB layer is sandwiched between two adjacent QD layers.

20. The QLED device of claim 19, wherein each QD layer comprises Cadmium Selenide/Zinc Sulfide (CdSe/ZnS).
21. The QLED device of claim 19 or 20, wherein each QB layer comprises Poly(methyl methacrylate) (PMMA).
22. The QLED device of any one of claims 19 to 21, wherein $n = 3$.
23. The QLED device of any one of claims 19 to 21, wherein $n = 5$.
24. The QLED device of any one of claims 19 to 21, wherein $2 \leq n \leq 6$.
25. The QLED device of any one of claims 19 to 24, wherein the thickness of each QD layer is about eight times of that of each QB layer.
26. The QLED device of any one of claims 19 to 24, wherein the thickness of each QD layer is about 15 nm to 35 nm, and wherein the thickness of each QB layer is about 1 nm to 5 nm.
27. The QLED device of any one of claims 19 to 24, wherein the thickness of each QD layer is about 15 nm to 35 nm, and wherein the thickness of each QB layer is about 2 nm to 4 nm.
28. The QLED device of any one of claims 19 to 27, wherein the cathode layer comprises silver, and the anode layer comprises Indium Tin Oxide (ITO).
29. The QLED device of any one of claims 19 to 28, wherein the ETL comprises synthesized ZnO nanocrystals, and the HIL comprises poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT:PSS).
30. The QLED device of any one of claims 19 to 29 further comprising:
a hole-transport layer (HTL) sandwiched between the active emission region and the HIL.
31. The QLED device of claim 30, wherein the HTL comprises poly(9-vinylcarbazole) (PVK).

32. The QLED device of any one of claims 19 to 31 further comprising:
a transparent substrate coupled to the anode on the second side thereof.
33. The QLED device of claim 31 wherein the anode layer is a transparent layer coated on the substrate; and wherein when a voltage is applied between the anode and cathode of the QLED device, the QLED device emits light from the second side.
34. The QLED device of any one of claims 19 to 33, wherein each QB layer has a conductive band higher than that each QD layer.
35. The QLED device of claim 34, wherein the energy at the valence band of each QB layer is higher than the energy at the valence band of each QD layer.
36. The QLED device of claim 19 or 20, wherein each QB layer comprises PVK, 4,4'-Cyclohexylidenebis[N,N-bis(4-methylphenyl)benzenamine] (TAPC), or Poly[N,N'-bis(4-butylphenyl)-N,N'-bisphenylbenzidine] (Poly-TPD).