SUMMARY

[0005] An aspect of the present invention provides a light emitting device comprising a plasmonic structure comprising a plurality of periodicities configured to have a corresponding plurality of localized surface plasmon resonances; a broadband light emitting layer comprising a mixture of a plurality of narrowband emitters, each narrowband emitter having a respective spectral peak, the broadband light emitting layer comprising an emission spectrum substantially overlapping wavelengths of the localized surface plasmon resonances; and a spacer layer disposed between the plasmonic structure and the broadband light emitting layer; wherein a color of light emitted by the broadband light emitting layer is tunable by the localized surface plasmon resonances of the plasmonic structure.

[0006] The spacer layer may comprise a thickness configured to enable exciton-plasmon coupling between the broadband light emitting layer and the plasmonic structure.

[0007] The device may be configured to be integrated to a light emitting diode (LED) structure such that the charge injection or transport layer of the LED structure comprises the spacer layer and is disposed between the plasmonic structure and the broadband light emitting layer.

[0008] The device may be configured to be integrated to a light emitting diode (LED) structure such that an electron injection layer of the LED structure comprises the plasmonic structure.

[0009] The periodicities may be in the range of 190 nm to 314 nm.

[0010] The plasmonic structure may be configured to control at least one of a polarization, beam direction and phase of light emitted by the broadband light emitting layer.

[0011] The plasmonic structure may comprise a nanostructured array.

[0012] The narrowband emitters may comprise quantum dots.

[0013]

[0014] Another aspect of the present invention provides a method of controlling light emission comprising providing a plasmonic structure comprising a plurality of periodicities capable of having a corresponding plurality of localized surface plasmon resonances; providing a broadband light emitting layer adjacent to the plasmonic structure to enable exciton-plasmon coupling between the broadband light emitting layer and the plasmonic structure, the broadband light emitting layer comprising an emission spectrum substantially overlapping wavelengths of the localized surface plasmon resonances; and controlling the localized surface plasmon resonances of the plasmonic structure to tune a color of light emitted by the broadband light emitting layer, wherein providing the broadband light emitting layer comprises providing a mixture of a plurality of narrowband emitters, each narrowband emitter having a respective spectral peak.

[0015] The method may further comprise providing a spacer layer between the plasmonic structure and the broadband light emitting layer, the spacer layer having a predetermined thickness to enable the exciton-plasmon coupling between the broadband light emitting layer and the plasmonic structure.

[0016] The periodicities may be selected to be in the range of 190 nm to 314 nm.

[0017] The method may further comprise controlling, by the plasmonic structure, at least one of a polarization, beam direction and phase of the light emitted by the broadband light emitting layer.

[0018] The plasmonic structure may comprise a nanostructured array.

[0019] The narrowband emitters may comprise quantum dots.

[0020]

[0021] Controlling the localized surface plasmon resonances may comprise varying an enhancement factor.

[0022] Another aspect of the present invention provides a method fabricating a light emitting device, the method comprising forming a plasmonic structure having a plurality of periodicities corresponding to a plurality of localized surface plasmon resonances; forming a broadband light emitting layer comprising an emission spectrum substantially overlapping wavelengths of the localized surface plasmon resonances; and disposing a spacer layer between the plasmonic structure and the broadband emitting layer such that exciton-plasmon coupling between the broadband light emitting layer and the plasmonic structure is enabled, wherein forming the broadband light emitting layer comprises mixing a plurality of narrowband emitters, each narrowband emitter having a respective spectral peak.

[0023] Forming the broadband light emitting layer may comprise forming the layer in a single deposition step.

[0024] Forming the plasmonic structure may comprise patterning a nanostructured array.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] Embodiments of the invention will be better understood and readily apparent to one of ordinary skill in the art from the following written description, by way of example only, and in conjunction with the drawings, in which:

[0026] Figures 1(A)-(E) show details of a light emitting device according to an example embodiment.

[0027] Figures 2(A)-(B) show reflectance images of regions 1-8 of the device of Figure 1.

[0028] Figures 3(A) and (B) show reflectance and transmittance spectra, respectively, of regions 1-8 of the device of Figure 1.

[0029] Figures 4(A)-(B) show photoluminescence images of regions 1-8 of the device of Figure 1.

[0030] Figures 5 shows photoluminescence spectra of regions 1-8 of the device of Figure 1 against a reference spectrum.

[0031] Figures 6(A)-(C) show time-resolved photoluminescence measurements of regions 1, 5 and 7 of the device of Figure 1 at different wavelengths.

CLAIMS

1. A light emitting device comprising:

a plasmonic structure comprising a plurality of periodicities configured to have a corresponding plurality of localized surface plasmon resonances;

a broadband light emitting layer comprising a mixture of a plurality of narrowband emitters, each narrowband emitter having a respective spectral peak, the broadband light emitting layer comprising an emission spectrum substantially overlapping wavelengths of the localized surface plasmon resonances; and

a spacer layer disposed between the plasmonic structure and the broadband light emitting layer;

wherein a color of light emitted by the broadband light emitting layer is tunable by the localized surface plasmon resonances of the plasmonic structure.

2. The light emitting device as claimed in claim 1, wherein the spacer layer comprises a thickness configured to enable exciton-plasmon coupling between the broadband light emitting layer and the plasmonic structure.

3. The light emitting device as claimed in claim 1 or 2, wherein the device is configured to be integrated to a light emitting diode (LED) structure such that a charge injection or transport layer of the LED structure comprises the spacer layer and is disposed between the plasmonic structure and the broadband light emitting layer.

4. The light emitting device as claimed in claim 1 or 2, wherein the device is configured to be integrated to a light emitting diode (LED) structure such that an electron injection layer of the LED structure comprises the plasmonic structure.

5. The light emitting device as claimed in any one of the preceding claims, wherein the periodicities are in the range of 190 nm to 314 nm.

6. The light emitting device as claimed in any one of the preceding claims, wherein the plasmonic structure is configured to control at least one of a polarization, beam direction and phase of light emitted by the broadband light emitting layer.

7. The light emitting device as claimed in any one of the preceding claims, wherein the plasmonic structure comprises a nanostructured array.

8. The light emitting device as claimed in any one of the preceding claims, wherein the narrowband emitters comprise quantum dots.

9. A method of controlling light emission comprising:

providing a plasmonic structure comprising a plurality of periodicities capable of having a corresponding plurality of localized surface plasmon resonances;

providing a broadband light emitting layer adjacent to the plasmonic structure to enable exciton-plasmon coupling between the broadband light emitting layer and the plasmonic structure, the broadband light emitting layer comprising an emission spectrum substantially overlapping wavelengths of the localized surface plasmon resonances; and

controlling the localized surface plasmon resonances of the plasmonic structure to tune a color of light emitted by the broadband light emitting layer,

wherein providing the broadband light emitting layer comprises providing a mixture of a plurality of narrowband emitters, each narrowband emitter having a respective spectral peak.

10. The method as claimed in claim 9, further comprising providing a spacer layer between the plasmonic structure and the broadband light emitting layer, the spacer layer having a predetermined thickness to enable the exciton-plasmon coupling between the broadband light emitting layer and the plasmonic structure.

11. The method as claimed in claim 9 or 10, wherein the periodicities are selected to be in the range of 190 nm to 314 nm.

12. The method as claimed in any one of claims 9 to 11, further comprising controlling, by the plasmonic structure, at least one of a polarization, beam direction and phase of the light emitted by the broadband light emitting layer.

13. The method as claimed in any one of claims 9 to 12, wherein the plasmonic structure comprises a nanostructured array.

14. The method as claimed in any one of claims 9 to 13, wherein the narrowband emitters comprise quantum dots.

15. The method as claimed in any one of claims 9 to 14, wherein controlling the localized surface plasmon resonances comprises varying an enhancement factor.

16. A method fabricating a light emitting device, the method comprising:

forming a plasmonic structure having a plurality of periodicities corresponding to a plurality of localized surface plasmon resonances;

forming a broadband light emitting layer comprising an emission spectrum substantially overlapping wavelengths of the localized surface plasmon resonances; and

disposing a spacer layer between the plasmonic structure and the broadband emitting layer such that exciton-plasmon coupling between the broadband light emitting layer and the plasmonic structure is enabled,

wherein forming the broadband light emitting layer comprises mixing a plurality of narrowband emitters, each narrowband emitter having a respective spectral peak.

17. The method as claimed in claim 16, wherein forming the broadband light emitting layer further comprises forming the layer in a single deposition step.

18. The method as claimed in claim 16 or 17, wherein forming the plasmonic structure further comprises patterning a nanostructured array.