Claims

What is claimed:

1. A method of making a semiconductor device, comprising:

providing a semiconductor wafer ~~having~~including a plurality of active or passive devices formed on the semiconductor wafer;

forming a first conductive layer over the semiconductor wafer electrically connected to the active or passive devices;

forming an insulati~~o~~ng layer over the first conductive layer and semiconductor wafer;

removing a portion of the insulating layer to expose the first conductive layer;

forming a second conductive layer over the first conductive layer and insulati~~o~~ng layer;

forming a third conductive layer over the second conductive layer;

forming a fourth conductive layer over the third conductive layer;

forming a single core pillar ~~having~~including a hollow interior region over the fourth conductive layer and centered over first conductive layer, the single core pillar ~~having~~ including a width less than a width of the exposed first conductive layer;

forming a fifth conductive layer over the fourth conductive layer and single core pillar and ~~into~~within the hollow interior region;

forming a sixth conductive layer over the fifth conductive layer and single core pillar and ~~into~~within the hollow interior region; and

forming a bump material over the sixth conductive layer.

2. The method of claim 1, further including reflowing the bump material to form a spherical bump.

3. The method of claim 2, wherein the single core pillar extends into the spherical bump at least two-thirds of a height of the spherical bump.

4. The method of claim 2, wherein the single core pillar has a width 40-60% of a width of a diameter of the spherical bump.

5. The method of claim 1, wherein forming the single core pillar includes:

forming a photoresist layer;

forming an opening in the photoresist layer; and

depositing conductive material in the opening of the photoresist layer.

6. The method of claim 1, wherein the single core pillar includes copper, nickel, or other conductive material.

7. A method of making a semiconductor device, comprising:

providing a semiconductor substrate;

forming a first conductive layer over the semiconductor substrate;

forming an insulati~~o~~ng layer over the first conductive layer and semiconductor substrate;

removing a portion of the insulating layer to expose the first conductive layer;

forming an under bump metallization (UBM) layer over the first conductive layer;

forming a single core pillar including a hollow interior region over the UBM layer and centered over first conductive layer, the single core pillar ~~having~~including a width less than

a width of the exposed first conductive layer and extending into the bump at least two-thirds of a height of the bump;

forming a second conductive layer over the UBM layer and single core pillar;

forming a third conductive layer over the second conductive layer; and

forming a bump over the third conductive layer.

8. The method of claim 7, wherein forming the UBM layer includes:

forming a fourth conductive layer over the first conductive layer;

forming a fifth conductive layer over the fourth conductive layer; and

forming a sixth conductive layer over the fifth conductive layer.

~~9. The method of claim 7, wherein the core pillar extends into the bump at least two-thirds of a height of the bump.~~

~~10~~9. The method of claim 7, wherein the single core pillar has a width 40-60% of a width of a diameter of the bump.

~~11. The method of claim 7, further including forming the core pillar with a hollow interior region.~~

1~~2~~0. The method of claim ~~11~~7, further including:

forming the second conductive layer into the hollow interior region of the single core pillar; and

forming the third conductive layer over the second conductive layer and into the hollow interior region of the single core pillar.

131. The method of claim 7, wherein the single core pillar has a rectangular, cylindrical, or toroidal shape.

142. A method of making a semiconductor device, comprising:

providing a semiconductor substrate;

forming a first conductive layer over the semiconductor substrate;

forming an under bump metallization (UBM) layer over the first conductive layer;

forming a single core pillar including a hollow interior region over the UBM layer and centered over the first conductive layer, the single core pillar ~~having~~ including a width less than a width of the first conductive layer;

conformally applying a second conductive layer over the UBM layer and single core pillar; and

forming a bump over the second conductive layer.

153. The method of claim 142, wherein forming the UBM layer includes:

forming a third conductive layer over the first conductive layer;

forming a fourth conductive layer over the third conductive layer; and

forming a fifth conductive layer over the fourth conductive layer.

164. The method of claim 142, wherein the single core pillar extends into the bump at least two-thirds of a height of the bump.

175. The method of claim 142, wherein the single core pillar has

a width 40-60% of a width of a diameter of the bump.

~~18. The method of claim 14, further including forming the core pillar with a hollow interior region.~~

19. The method of claim 18, further including conformally applying the second conductive layer over the single core pillar and into the hollow interior region.

~~20~~17. The method of claim 1~~4~~2, wherein the single core pillar has a rectangular, cylindrical, or toroidal shape.

~~21~~18. A method of making a semiconductor device, comprising:

providing a semiconductor substrate;

forming a first conductive layer over the semiconductor substrate;

forming an under bump metallization (UBM) layer over the first conductive layer;

forming a core pillar over the UBM layer and first conductive layer, the core pillar ~~having~~including a width less than a width of the first conductive layer;

forming a barrier layer within a hollow interior region of the core pillar;

forming a wetting layer within the hollow interior region of the core pillar; and

forming a bump over the core pillar.

~~22. The method of claim 21, further including forming a second conductive layer over the UBM layer and core pillar.~~

~~23~~19. The method of claim ~~2~~18, wherein the core pillar extends into the bump at least two-thirds of a height of the

bump.

240. The method of claim 218, wherein the core pillar has a width 40-60% of a width of a diameter of the bump.

~~25. The method of claim 21, further including:~~

~~forming the core pillar with a hollow interior region; and~~

~~forming the second conductive layer into the hollow interior region of the core pillar.~~

21. The method of claim 18, wherein forming the UBM layer includes:

forming a fourth conductive layer over the first conductive layer;

forming a fifth conductive layer over the fourth conductive layer; and

forming a sixth conductive layer over the fifth conductive layer.