CLAIMS

WHAT IS CLAIMED:

1. A method, comprising:

forming a conductive pad in a layer of insulating material;

forming a passivation layer above said conductive pad and said layer of insulating material;

performing at least one etching process on said passivation layer to define an opening in said passivation layer that exposes at least a portion of said conductive pad;

forming a protective layer on said passivation layer, in said opening and on said exposed portion of said conductive pad;

forming a heat-curable material layer above said protective layer;

performing an etching process on said heat-curable material layer to define a patterned heat-curable material layer having an opening that exposes a portion of said protective layer;

performing an etching process to remove said exposed portion of said protective layer to thereby expose at least a portion of said conductive pad; and

after removing said exposed portion of said protective layer, forming a conductive bump that is conductively coupled to said conductive pad.

2. The method of claim 1, wherein forming said heat-curable material layer above said protective layer comprises depositing a heat-curable material for said heat-curable material layer and performing a heating process to cure said heat-curable

material for said heat-curable material layer while said protective layer is positioned on said exposed portion of said conductive pad.

3. The method of claim 1, wherein forming said passivation layer above said conductive pad and said layer of insulating material comprises forming a multi-layer passivation layer above said conductive pad and said layer of insulating material.

4. The method of claim 3, wherein said multi-layer passivation layer is comprised of a first layer comprised of silicon, carbon and nitrogen formed on said layer of insulating material, a second layer comprised of silicon dioxide formed on said first layer and a third layer comprised of silicon nitride formed on said second layer.

5. The method of claim 1, wherein forming said conductive pad in said layer of insulating material comprises forming a conductive pad comprised of copper in said layer of insulating material.

6. The method of claim 1, wherein forming said conductive bump comprises forming a conductive bump comprised of tin and silver, SnAg, or SnAgCu.

7. The method of claim 1, wherein, prior to forming said conductive bump, forming an under bump metallization layer that contacts said conductive pad, said protection layer and said patterned heat-curable material layer.

8. The method of claim 1, wherein forming said protective layer on said passivation layer comprises depositing a protective layer comprised of one of silicon

dioxide or silicon oxyfluoride (SiOF), silicon nitride (SiN) or silicone carbon nitride (SiCN) on said passivation layer.

9. The method of claim 8, wherein said protective layer has a thickness of 20-300 nm.

10. The method of claim 1, wherein said heat-curable material layer is comprised of one of polyimide and polybenzoxadiaziole (PBO).

11. A device, comprising:

first and second spaced-apart conductive pads positioned in a layer of insulating material;

first and second under-bump metallization layers that are conductively coupled to said first and second conductive pads, respectively;

first and second spaced-apart conductive bumps, each of which are conductively coupled to said first and second under-bump metallization layers, respectively;

a passivation layer positioned above said layer of insulating material between said first and second spaced-apart conductive bumps; and

a protective layer positioned on said layer of insulating material, said protective layer extending between and contacting said first and second under-bump metallization layers.

12. The device of claim 11, wherein said protective layer is comprised of one of silicon dioxide or silicon oxyfluoride (SiOF), silicon nitride (SiN) or silicone carbon nitride (SiCN).

13. The device of claim 12, wherein said protective layer has a thickness of 20-300 nm.

14. The device of claim 11, wherein each of said first and second gate spaced-apart conductive bumps are comprised of tin and silver, SnAg, or SnAgCu.

15. The device of claim 14, wherein first and second spaced-apart conductive pads are comprised of copper.

16. The device of claim 11 wherein said passivation layer is a multi-layer passivation layer comprised of a first layer comprised of silicon, carbon and nitrogen formed on said layer of insulating material, a second layer comprised of silicon dioxide formed on said first layer and a third layer comprised of silicon nitride formed on said second layer.

17. The device of claim 16, wherein said protective layer is formed on said third layer.

18. The device of claim 11, further comprising a heat-curable material layer formed on said protective layer, said heat-curable material layer extending between and contacting said first and second under-bump metallization layers.

19. The device of claim 18, wherein said heat-curable material layer is comprised of one of polyimide and polybenzoxadiaziole (PBO).

20. A method, comprising:

forming a conductive pad in a layer of insulating material;

forming a multi-layer passivation layer above said conductive pad and above said layer of insulating material, a first layer of said multi-layer passivation layer being in contact with said conductive pad and said layer of insulating material;

performing at least one etching process on said multi-layer passivation layer to remove at least one layer of said multi-layer passivation layer, said at least one etching process defining an etched passivation layer having a recess that exposes at least a portion of said first layer;

forming a heat-curable material layer above said etched passivation layer and said exposed portion of said first layer;

performing an etching process on said heat-curable material layer to define a patterned heat-curable material layer having an opening that exposes a portion of said etched passivation layer and said exposed portion of said first layer;

performing an etching process to remove said exposed portion of said first layer to thereby expose at least a portion of said conductive pad; and

after removing said exposed portion of said first layer, forming a conductive bump that is conductively coupled to said conductive pad.

21. The method of claim 20, wherein forming said heat-curable material layer above said etched passivation layer and said exposed portion of said first layer

comprises depositing heat-curable material for said heat-curable material layer and performing a heating process to cure said heat-curable material for said heat-curable material layer while said exposed portion of said first layer is positioned on said conductive pad.

22. The method of claim 20, wherein forming said multi-layer passivation layer comprises forming a first layer comprised of silicon, carbon and nitrogen on said layer of insulating material, forming a second layer comprised of silicon dioxide on said first layer and forming a third layer comprised of silicon nitride on said second layer.

23. The method of claim 20, wherein forming said conductive pad in said layer of insulating material comprises forming a conductive pad comprised of copper in said layer of insulating material.

24. The method of claim 20, wherein forming said conductive bump comprises forming a conductive bump comprised of tin and silver, SnAg, or SnAgCu.

25. The method of claim 20, wherein said heat-curable material layer is comprised of one of polyimide and polybenzoxadiaziole (PBO).

CLAIMS

1. A method, comprising:

forming a conductive pad in a layer of insulating material;

forming a passivation layer above said conductive pad and said layer of insulating material;

performing at least one etching process on said passivation layer to define an opening in said passivation layer that exposes at least a portion of said conductive pad;

forming a protective layer comprising of one of silicon dioxide, silicon oxyfluoride (SiOF), silicon nitride (SiN), and silicone carbon nitride (SiCN) on said passivation layer, in said opening and on said exposed portion of said conductive pad;

forming a heat-curable material layer above said protective layer;

performing an etching process on said heat-curable material layer to define a patterned heat-curable material layer having an opening that exposes a portion of said protective layer;

performing an etching process to remove said exposed portion of said protective layer to thereby expose at least a portion of said conductive pad; and

after removing said exposed portion of said protective layer, forming a conductive bump that is conductively coupled to said conductive pad.

2. The method of claim 1, wherein forming said heat-curable material layer above said protective layer comprises depositing a heat-curable material for said heat-curable material layer and performing a heating process to cure said heat-curable material for said heat-curable material layer while said protective layer is positioned on said exposed portion of said conductive pad.

3. The method of claim 1, wherein forming said passivation layer above said conductive pad and said layer of insulating material comprises forming a multi-layer passivation layer above said conductive pad and said layer of insulating material.

4. The method of claim 3, wherein said multi-layer passivation layer is comprised of a first layer comprised of silicon, carbon and nitrogen formed on said layer of insulating material, a second layer comprised of silicon dioxide formed on said first layer and a third layer comprised of silicon nitride formed on said second layer.

5. The method of claim 1, wherein forming said conductive pad in said layer of insulating material comprises forming a conductive pad comprised of copper in said layer of insulating material.

6. The method of claim 1, wherein forming said conductive bump comprises forming a conductive bump comprised of tin and at least one of silver and copper.

7. The method of claim 1, wherein, prior to forming said conductive bump, forming an under bump metallization layer that contacts said conductive pad, said protection layer and said patterned heat-curable material layer.

8. The method of claim 1, wherein said protective layer has a thickness of 20-300 nm.

9. The method of claim 1, wherein said heat-curable material layer is comprised of one of polyimide and polybenzoxadiaziole (PBO).

10. A method, comprising:

forming a conductive pad in a layer of insulating material;

forming a multi-layer passivation layer above said conductive pad and above said layer of insulating material, a first layer of said multi-layer passivation layer being in contact with said conductive pad and said layer of insulating material;

performing at least one etching process on said multi-layer passivation layer to remove at least one layer of said multi-layer passivation layer, said at least one etching process defining an etched passivation layer having a recess that exposes at least a portion of said first layer;

forming a heat-curable material layer above said etched passivation layer and said exposed portion of said first layer;

performing an etching process on said heat-curable material layer to define a patterned heat-curable material layer having an opening that exposes a portion of said etched passivation layer and said exposed portion of said first layer;

performing an etching process to remove said exposed portion of said first layer to thereby expose at least a portion of said conductive pad; and

after removing said exposed portion of said first layer, forming a conductive bump that is conductively coupled to said conductive pad.

11. The method of claim 10, wherein forming said heat-curable material layer above said etched passivation layer and said exposed portion of said first layer comprises depositing heat-curable material for said heat-curable material layer and performing a heating process to cure said heat-curable material for said heat-curable material layer while said exposed portion of said first layer is positioned on said conductive pad.

12. The method of claim 10, wherein forming said multi-layer passivation layer comprises forming a first layer comprised of silicon, carbon and nitrogen on said layer of insulating material, forming a second layer comprised of silicon dioxide on said first layer and forming a third layer comprised of silicon nitride on said second layer.

13. The method of claim 10, wherein forming said conductive pad in said layer of insulating material comprises forming a conductive pad comprised of copper in said layer of insulating material.

14. The method of claim 10, wherein forming said conductive bump comprises forming a conductive bump comprised of tin and at least one of silver and copper.

15. The method of claim 10, wherein said heat-curable material layer is comprised of one of polyimide and polybenzoxadiaziole (PBO).

16. A semiconductor device having conductive bumps, said conductive bumps are formed by the method of any one of the preceding claims.