CLAIMS

1. A method comprising:

forming a final metallization layer of a metallization system of a semiconductor device in a first manufacturing environment, said metallization system being formed above a substrate comprising a plurality of die regions, said final metallization layer comprising contact regions having a copper-containing contact surface;

forming a passivation layer stack above said final metallization layer;

patterning said passivation layer stack so as to form an opening above a portion of said copper-containing contact surface of each of said contact regions; and

forming a protection layer on at least said portion of said copper-containing contact surface of each of said contact regions prior to processing said semiconductor device in a second manufacturing environment that is remote from said first manufacturing environment.

2. The method of claim 1, wherein said protection layer is formed prior to forming said passivation layer stack.

3. The method of claim 2, wherein patterning said passivation layer stack comprises performing an etch process and stopping said etch process without exposing said portion of said copper-containing contact surface.

4. The method of claim 1, wherein patterning said passivation layer stack comprises exposing said portion of said copper-containing contact surface.

5. The method of claim 4, wherein said protection layer is formed on said passivation layer stack and on said exposed portion of said copper-containing contact surface.

6. The method of claim 4, wherein said protection layer is formed selectively on said exposed portion of said copper-containing contact surface.

7. The method of claim 6, wherein said protection layer is formed as a copper oxide layer.

8. The method of claim 1, wherein forming said protection layer comprises forming a silicon and oxygen containing material layer.

9. The method of claim 1, further comprising removing said protection layer at least from said portion of said copper-containing contact surface in said second manufacturing environment by performing a wet chemical etch process.

10. The method of claim 9, wherein said wet chemical etch process is performed as a non-masked etch process.

11. The method of claim 9, wherein said wet chemical etch process is performed on the basis of hydrofluoric acid (HF).

12. A method comprising:

forming a metallization system of a semiconductor device on the basis of copper in a manufacturing environment, said metallization system comprising a final metallization layer comprising a plurality of metal contact regions;

forming a protection layer on said final metallization layer;

forming a passivation layer stack above said protection layer; and

performing an etch process in said manufacturing environment so as to form an opening in said passivation layer stack above each of said plurality of metal contact regions without etching through said protection layer.

13. The method of claim 12, further comprising transporting said semiconductor device to a second manufacturing environment and removing said protection layer within each of said openings by performing a wet chemical etch process.

14. The method of claim 13, wherein performing said wet chemical etch process comprises performing a non-masked etch process.

15. The method of claim 13, wherein said wet chemical etch process is performed on the basis of hydrofluoric acid (HF).

16. The method of claim 12, further comprising forming a cap layer above said protection layer prior to forming said passivation layer stack, wherein performing said etch process comprises etching through said cap layer and using said protection layer as an etch control layer.

17. The method of claim 16, wherein said protection layer is formed so as to act as an etch stop layer in said etch process.

18. The method of claim 17, wherein said dielectric material is formed as a silicon and oxygen containing material.

19. A semiconductor device comprising:

a plurality of die regions formed on a carrier material, each of said die regions comprising a metallization system, said metallization system comprising a final metallization layer having a copper-based metal region including a copper-containing contact surface;

a cap layer formed above said final metallization layer;

a passivation layer stack formed above said cap layer and comprising an opening positioned above and aligned with a portion of said copper-containing contact surface; and

a protection layer formed on said portion of said copper-containing contact surface.

20. The semiconductor device of claim 19, wherein said protection layer is formed below said cap layer and differs in material composition from said cap layer.

Claims:

1. A method, comprising:

forming a final metallization layer of a metallization system of a semiconductor device in a first manufacturing environment, said metallization system being formed above a substrate comprising a plurality of die regions, said final metallization layer comprising contact regions having a copper-containing contact surface positioned in a layer of insulating material;

forming a dielectric cap layer on and in contact with an upper surface of the layer of insulating material and on and in contact with the copper-containing contact surface, wherein the dielectric cap layer is comprised of silicon nitride or silicon carbide;

forming a passivation layer stack above said final metallization layer and on and in contact with an upper surface of the dielectric cap layer;

patterning said passivation layer stack and the dielectric cap layer so as to form an opening through the passivation layer stack and the dielectric cap layer and that exposes a portion of said copper-containing contact surface of each of said contact regions;

performing a conformal deposition process to form a protection liner layer on said exposed portion of said copper-containing contact surface of each of said contact regions and on an upper surface of the patterned passivation layer stack an on the patterned dielectric cap layer prior to processing said semiconductor device in a second manufacturing environment that is remote from said first manufacturing environment; and

removing said protection liner layer at least from above said previously exposed portion of said copper-containing contact surface in said second manufacturing environment by performing a wet chemical etch process, wherein said wet chemical etch process is performed in the absence of a photoresist etch mask.

2. The method of claim 1, wherein forming said protection liner layer comprises forming a silicon and oxygen containing material liner layer.

3. The method of claim 1, wherein said wet chemical etch process is performed on the basis of hydrofluoric acid (HF).

4. A method, comprising:

forming a metallization system of a semiconductor device comprised of copper in a manufacturing environment, said metallization system comprising a final metallization layer comprising a plurality of metal contact regions positioned in a layer of insulating material;

forming a dielectric cap layer on and in contact with an upper surface of the layer of insulating material and on and in contact with the metal contact regions, wherein the dielectric cap layer is comprised of silicon nitride or silicon carbide.

forming a passivation layer stack on and in contact with an upper surface of the dielectric cap layer;

patterning said passivation layer stack and the dielectric cap layer so as to form an opening through the passivation layer stack and the dielectric cap layer that exposes a portion of said copper-containing contact surface of each of said contact regions;

performing a conformal deposition process to form a protection liner layer comprised of silicon dioxide on said exposed portion of said metal contact regions and on an upper surface of the patterned passivation layer stack an on the patterned dielectric cap layer prior to processing said semiconductor device in a second manufacturing environment that is remote from said first manufacturing environment; and

transporting said semiconductor device to the second manufacturing environment and removing the first protection liner layer at least from above said previously exposed portion of the metal contact regions by performing a wet chemical etch process, wherein said wet chemical etch process is performed in the absence of a photoresist etch mask.

5. The method of claim 4, wherein said wet chemical etch process is performed on the basis of hydrofluoric acid (HF).

6. A method, comprising:

forming a final metallization layer of a metallization system of a semiconductor device in a first manufacturing environment, said metallization system being formed above a substrate comprising a plurality of die regions, said final metallization layer comprising contact regions having a copper-containing contact surface positioned in a layer of insulating material;

forming a dielectric cap layer on and in contact with an upper surface of the layer of insulating material and on and in contact with the copper-containing contact surface, wherein the dielectric cap layer is comprised of silicon nitride or silicon carbide;

forming a passivation layer stack above said final metallization layer and on and in contact with an upper surface of the dielectric cap layer;

patterning said passivation layer stack and the dielectric cap layer so as to form an opening through the passivation layer stack and the dielectric cap layer and that exposes a portion of said copper-containing contact surface of each of said contact regions; and

performing a conformal deposition process to form a protection liner layer on said exposed portion of said copper-containing contact surface of each of said contact regions and on an upper surface of the patterned passivation layer stack an on the patterned dielectric cap layer prior to processing said semiconductor device in a second manufacturing environment that is remote from said first manufacturing environment, wherein said protection liner layer comprises a silicon and oxygen containing material.

7. A semiconductor device manufactured in accordance with the method of any one of the preceding claims.