CLAIMS

1. A pixel cell comprising:

a photo-conversion device at a surface of a substrate;

a plurality of transistors, each comprising a gate and a source/drain region;

a first dielectric material over the photo-conversion device and over and in direct contact with the source/drain regions, and a second dielectric material in direct contact with a surface of the photo-conversion device and below the first dielectric material, the first dielectric material comprising tetraethyl orthosilicate; the first and second dielectric materials having an opening over a portion of one of the source/drain regions;

at least one conductor through the opening and in direct contact with at least one of the source/drain regions underneath the opening, wherein the at least one conductor comprises a polysilicon comprising material;

a conductive material over and in contact with the polysilicon comprising material, the conductive material comprising at least one of a silicide and a refractory metal;

a third dielectric material in contact with the first dielectric material, the second dielectric material comprising at least one of borophosphosilicate glass, silicon dioxide, borosilicate glass, or phosphosilicate glass; and

a fourth dielectric material in contact with the second dielectric material, the third dielectric material comprising at least one of borophosphosilicate glass, silicon dioxide, borosilicate glass, or phosphosilicate glass.

2. The pixel cell of claim 1, wherein the conductive material comprises a silicide.

3. The pixel cell of claim 2, wherein the silicide is selected from the group consisting of tungsten silicide, titanium silicide, cobalt silicide, molybdenum silicide, and tantalum silicide.

4. The pixel cell of claim 1, wherein the conductive material comprises a barrier metal/refractory metal layer.

5. The pixel cell of claim 4, wherein the conductive material comprises a tungsten nitride/tungsten layer.

6. The pixel cell of claim 4, wherein the conductive material comprises a titanium nitride/tungsten layer.

7. The pixel cell of claim 1, wherein the conductive material comprises a tungsten nitride layer.

8. The pixel cell of claim 1, wherein the polysilicon comprising material has a top surface on a same plane as a top surface of at least one of the dielectric materials.

9. The pixel cell of claim 1, wherein a top surface of the polysilicon comprising material is over a top surface of at least one of the dielectric materials.

10. The pixel cell of claim 1:

further comprising a plurality of openings in the first and second dielectric materials over each of the source/drain regions; and

a plurality of conductors, each conductor being in contact with a respective source/drain region through a respective opening.

11. The pixel cell of claim 1, wherein the conductor extends into a top portion of at least one of the source/drain regions.

12. The pixel cell of claim 1, wherein a top end of the conductor extends beyond the opening in a direction parallel to the substrate.

13. A pixel cell comprising:

a photo-conversion device at a surface of a substrate;

a plurality of transistors, each comprising a gate region;

a floating diffusion region;

a first dielectric material over and in contact with a surface of the photo-conversion device and the floating diffusion region, the first dielectric material comprising tetraethyl orthosilicate, wherein a portion of the first dielectric material over and in contact with the photo-conversion device is thicker than a portion of the first dielectric material over and in direct contact with the floating diffusion region;

the first dielectric material having an opening over a portion of the floating diffusion region;

at least one conductor through the opening and in direct contact with the floating diffusion region, wherein the at least one conductor comprises a polysilicon material;

a conductive material over and in contact with the polysilicon material, the conductive material comprising at least one of a silicide and a refractory metal; and

a second dielectric material covering the conductive material, the second dielectric material comprising at least one of borophosphosilicate glass, silicon dioxide, borosilicate glass, or phosphosilicate glass.

14. A pixel cell comprising:

a photo-conversion device at a surface of a substrate;

a plurality of transistors, each comprising a gate and a source/drain region;

a first dielectric having two parts, a first part which is over the gate, over the photo-conversion device, and over and in direct contact with at least one source/drain region, and a second part which is between and in contact with the first part and the photo-conversion device;

a second dielectric in contact with the first dielectric;

the first and second dielectrics having an opening over the at least one source/drain region; and

at least one conductive plug provided in the opening and in direct contact with the at least one source/drain region.

15. The pixel cell of claim 14, wherein the first part of the first dielectric and the second part of the first dielectric comprise different materials.

16. The pixel cell of claim 14, further comprising a third dielectric in contact with the second dielectric.

17. The pixel cell of claim 14, wherein the first dielectric comprises tetraethyl orthosilicate, silicon dioxide, silicon nitride, or oxynitride.

18. The pixel cell of claim 14, further comprising a conductive material over and in contact with the at least one conductive plug.

19. The pixel cell of claim 14, wherein the at least one conductive plug has a top surface on a same plane as a top surface of at least one of the dielectrics.

20. The pixel cell of claim 14, wherein the at least one conductive plug has a top surface that is above a top surface of at least one of the dielectrics.

21. A method of forming a pixel cell, the method comprising the acts of:

forming a photo-conversion device at a surface of a substrate;

forming at least one contact area;

forming at least a first insulating layer over the photo-conversion device and directly over and in contact with the at least one contact area, and a second insulating material (233) in contact with a surface of the photo-conversion device and below the first insulating material;

forming at least one opening in the first insulating layer;

forming a polysilicon comprising material within the at least one opening and in contact with the at least one contact area; and

forming a conductive material layer over and in contact with the polysilicon comprising material, the act of forming the conductive material layer comprising forming at least one of a silicide layer and a refractory metal layer.

22. The method of claim 21, wherein the act of forming the at least one contact area comprises forming a gate electrode.

23. The method of claim 22, wherein the act of forming the at least one contact area comprises forming a gate electrode of one of a transfer, reset, row select, and source-follower transistor.

24. The method of claim 21, wherein the act of forming the at least one contact area comprises forming a floating diffusion region.

25. The method of claim 21, wherein the act of forming the at least one contact area comprises forming a source/drain region of a transistor.

26. The method of claim 21, wherein the act of forming the conductive material layer comprises forming a silicide layer.

27. The method of claim 26, wherein the silicide layer comprises a silicide selected from the group consisting of a tungsten silicide, titanium silicide, cobalt silicide, molybdenum silicide, and tantalum silicide layer.

28. The method of claim 21, wherein the act of forming the conductive material layer comprises forming a barrier metal/refractory metal layer.

29. The method of claim 28, wherein the act of forming the conductive material layer comprises forming a tungsten nitride/tungsten layer.

30. The method of claim 28, wherein the act of forming the conductive material layer comprises forming a titanium nitride/tungsten layer.

31. The method of claim 21, further comprising the act of forming a third insulating layer over the photo-conversion device and below the first insulating layer.

32. The method of claim 21, further comprising the act of planarizing the polysilicon comprising material and the first insulating layer such that the polysilicon comprising material has a top surface on a same plane as a top surface of the first insulating layer.

33. The method of claim 32, further comprising the act of forming a conductive material layer over and in contact with the polysilicon comprising material, wherein the act of forming the conductive material layer comprises forming a polysilicon/barrier metal/refractory metal layer.

34. The method of claim 32, further comprising the act of forming a conductive material layer over and in contact with the polysilicon comprising material, wherein the act of forming the conductive material layer comprises forming a polysilicon/silicide layer.

35. The method of claim 21, further comprising the acts of forming a plurality of contact areas and forming a plurality of openings, each opening formed to expose a respective contact area, wherein the polysilicon comprising layer is formed within each of the openings and in contact with a respective contact area.

36. The method of claim 21, further comprising the acts of:

forming at least one line coupled to the polysilicon comprising material; and coupling the at least one line to circuitry external to the pixel cell.

37. A method of forming a pixel cell, the method comprising the acts of:

forming a photo-conversion device at a surface of a substrate;

forming a first transistor coupled to the photo-conversion device, the first transistor having a gate electrode and a gate insulator over the gate electrode;

forming at least one insulating layer over the photo-conversion device and over and in contact with the first transistor, wherein a portion of the at least one insulating layer over the photo-conversion device is thicker than a portion of the at least one insulating layer over the first transistor;

forming a first opening in the at least one insulating layer and the gate insulator, the first opening extending to the gate electrode;

providing a polysilicon comprising layer in the first opening and in contact with the gate electrode.

38. The method of claim 37, further comprising the acts of:

providing a conductive layer over and in contact with the polysilicon comprising layer, the conductive layer comprising at least one of a silicide and a refractory metal.

39. The method of claim 37, further comprising the acts of: forming a floating diffusion region coupled to the first transistor; and

forming a second opening in a second insulating layer, the second opening extending to the floating diffusion region, wherein the act of forming the polysilicon comprising layer comprises forming the polysilicon comprising layer in the second opening.

40. The method of claim 37, further comprising the act of forming first and second insulating layers over the photo-conversion device.

41. The method of claim 37, wherein the act of forming the at least one insulating layer comprises forming a borophosphosilicate glass layer.

42. The method of claim 37, the act of forming the at least one insulating layer comprises forming a tetraethyl orthosilicate layer.

CLAIMS

1. A pixel cell (200) comprising:

a photo-conversion device (21) at a surface of a substrate (11);

a plurality of transistors, each comprising a gate and a source/drain region (60);

a first dielectric material (234) over the photo-conversion device and over and in direct contact with the source/drain regions, and a second dielectric material (233) in direct contact with a surface of the photo-conversion device and below the first dielectric material, the first dielectric material comprising tetraethyl orthosilicate; the first and second dielectric materials having an opening over a portion of one of the source/drain regions;

at least one conductor (271) through the opening and in direct contact with at least one of the source/drain regions underneath the opening, wherein the at least one conductor comprises a polysilicon comprising material;

a conductive material (272) over and in contact with the polysilicon comprising material, the conductive material comprising at least one of a silicide and a refractory metal;

a third dielectric material (250) in contact with the first dielectric material, the second dielectric material comprising at least one of borophosphosilicate glass, silicon dioxide, borosilicate glass, or phosphosilicate glass; and

a fourth dielectric material (251) in contact with the second dielectric material, the third dielectric material comprising at least one of borophosphosilicate glass, silicon dioxide, borosilicate glass, or phosphosilicate glass.

2. The pixel cell of claim 1, wherein the conductive material comprises a silicide.

3. The pixel cell of claim 2, wherein the silicide is selected from the group consisting of tungsten silicide, titanium silicide, cobalt silicide, molybdenum silicide, and tantalum silicide.

4. The pixel cell of claim 1, wherein the conductive material comprises a barrier metal/refractory metal layer.

5. The pixel cell of claim 4, wherein the conductive material comprises a tungsten nitride/tungsten layer.

6. The pixel cell of claim 4, wherein the conductive material comprises a titanium nitride/tungsten layer.

7. The pixel cell of claim 1, wherein the conductive material comprises a tungsten nitride layer.

8. The pixel cell of claim 1, wherein the polysilicon comprising material has a top surface on a same plane as a top surface of at least one of the dielectric materials.

9. The pixel cell of claim 1, wherein a top surface of the polysilicon comprising material is over a top surface of at least one of the dielectric materials.

10. The pixel cell of claim 1:

further comprising a plurality of openings in the first and second dielectric materials over each of the source/drain regions; and

a plurality of conductors, each conductor being in contact with a respective source/drain region through a respective opening.

11. The pixel cell of claim 1, wherein the conductor extends into a top portion of at least one of the source/drain regions.

12. The pixel cell of claim 1, wherein a top end of the conductor extends beyond the opening in a direction parallel to the substrate.

13. A pixel cell (200) comprising:

a photo-conversion device (21) at a surface of a substrate (11);

a plurality of transistors, each comprising a gate region;

a floating diffusion region (25);

a first dielectric material over and in contact with a surface of the photo-conversion device and the floating diffusion region, the first dielectric material comprising tetraethyl orthosilicate, wherein a portion of the first dielectric material over and in contact with the photo-conversion device is thicker than a portion of the first dielectric material over and in direct contact with the floating diffusion region;

the first dielectric material having an opening over a portion of the floating diffusion region;

at least one conductor (271) through the opening and in direct contact with the floating diffusion region, wherein the at least one conductor comprises a polysilicon material;

a conductive material (272) over and in contact with the polysilicon material, the conductive material comprising at least one of a silicide and a refractory metal; and

a second dielectric material covering the conductive material, the second dielectric material comprising at least one of borophosphosilicate glass, silicon dioxide, borosilicate glass, or phosphosilicate glass.

14. A pixel cell (200) comprising:

a photo-conversion device (21) at a surface of a substrate (11);

a plurality of transistors, each comprising a gate and a source/drain region;

a first dielectric having two parts, a first part (234) which is over the gate, over the photo-conversion device, and over and in direct contact with at least one source/drain region, and a second part (233) which is between and in contact with the first part and the photo-conversion device;

a second dielectric in contact with the first dielectric;

the first and second dielectrics having an opening over the at least one source/drain region; and

at least one conductive plug provided in the opening and in direct contact with the at least one source/drain region.

15. The pixel cell of claim 14, wherein the first part of the first dielectric and the second part of the first dielectric comprise different materials.

16. The pixel cell of claim 14, further comprising a third dielectric in contact with the second dielectric.

17. The pixel cell of claim 14, wherein the first dielectric comprises tetraethyl orthosilicate, silicon dioxide, silicon nitride, or oxynitride.

18. The pixel cell of claim 14, further comprising a conductive material over and in contact with the at least one conductive plug.

19. The pixel cell of claim 14, wherein the at least one conductive plug has a top surface on a same plane as a top surface of at least one of the dielectrics.

20. The pixel cell of claim 14, wherein the at least one conductive plug has a top surface that is above a top surface of at least one of the dielectrics.

21. A method of forming a pixel cell, the method comprising the acts of:

forming a photo-conversion device (21) at a surface of a substrate (11);

forming a[[t least one]] plurality of contact areas;

forming at least a first insulating layer (234) over the photo-conversion device and over and in direct contact with [[the]] at least one of the contact areas, and a second insulating material (233) in direct contact with a surface of the photo-conversion device and below the first insulating material;

forming at least one opening in the first (234) and second (233) insulating layers;

forming a polysilicon comprising material within the at least one opening and in direct contact with the at least one of the contact areas; and

forming a conductive material layer over and in contact with the polysilicon comprising material, the act of forming the conductive material layer comprising forming at least one of a silicide layer and a refractory metal layer.

22. The method of claim 21, wherein the act of forming the plurality of contact areas comprises forming a gate electrode.

23. The method of claim 22, wherein the act of forming the plurality of contact areas comprises forming a gate electrode of one of a transfer, reset, row select, and source-follower transistor.

24. The method of claim 21, wherein the act of forming the plurality of contact areas comprises forming a floating diffusion region.

25. The method of claim 21, wherein the act of forming the plurality of contact areas comprises forming a source/drain region of a transistor.

26. The method of claim 21, wherein the act of forming the conductive material layer comprises forming a silicide layer.

27. The method of claim 26, wherein the silicide layer comprises a silicide selected from the group consisting of a tungsten silicide, titanium silicide, cobalt silicide, molybdenum silicide, and tantalum silicide layer.

28. The method of claim 21, wherein the act of forming the conductive material layer comprises forming a barrier metal/refractory metal layer.

29. The method of claim 28, wherein the act of forming the conductive material layer comprises forming a tungsten nitride/tungsten layer.

30. The method of claim 28, wherein the act of forming the conductive material layer comprises forming a titanium nitride/tungsten layer.

31. The method of claim 21, further comprising the act of forming a third insulating layer over the photo-conversion device and below the first insulating layer.

32. The method of claim 21, further comprising the act of planarizing the polysilicon comprising material and the first insulating layer such that the polysilicon comprising material has a top surface on a same plane as a top surface of the first insulating layer.

33. The method of claim 32, further comprising the act of forming a conductive material layer over and in contact with the polysilicon comprising material, wherein the act of forming the conductive material layer comprises forming a polysilicon/barrier metal/refractory metal layer.

34. The method of claim 32, further comprising the act of forming a conductive material layer over and in contact with the polysilicon comprising material, wherein the act of forming the conductive material layer comprises forming a polysilicon/silicide layer.

35. The method of claim 21, further comprising the actof forming a plurality of openings, each opening formed to expose a respective contact area, wherein the polysilicon comprising layer is formed within each of the openings and in contact with a respective contact area.

36. The method of claim 21, further comprising the acts of:

forming at least one line coupled to the polysilicon comprising material; and coupling the at least one line to circuitry external to the pixel cell.

37. A method of forming a pixel cell, the method comprising the acts of:

forming a photo-conversion device (21) at a surface of a substrate (11);

forming a first transistor coupled to the photo-conversion device, the first transistor having a gate electrode and a gate insulator over the gate electrode;

forming a floating diffusion region coupled to the first transistor;

forming at least one insulating layer over and in contact with a surface of the photo-conversion device and the floating diffusion region, wherein a portion of the at least one insulating layer over the photo-conversion device is thicker than a portion of the at least one insulating layer over and in direct contact with the floating diffusion region;

forming a first opening in the at least one insulating layer and the gate insulator, the first opening extending to the gate electrode;

forming a second opening in the at least one insulating layer over a portion of the floating diffusion region;

providing a polysilicon comprising layer in the first opening and in contact with the gate electrode

forming a conductor through the opening and in direct contact with the floating diffusion region, wherein the conductor comprises a polysilicon material.

38. The method of claim 37, further comprising the acts of:

providing a conductive layer over and in contact with the polysilicon comprising layer, the conductive layer comprising at least one of a silicide and a refractory metal.

39. The method of claim 37, further comprising the act of forming first and second insulating layers over the photo-conversion device.

40. The method of claim 37, wherein the act of forming the at least one insulating layer comprises forming a borophosphosilicate glass layer.

41. The method of claim 37, the act of forming the at least one insulating layer comprises forming a tetraethyl orthosilicate layer.