CLAIMS

What is claimed is:

1. A pixel array of an image sensor supported by a substrate of a first conductivity type, comprising:

a first pixel configured to detect a blue light; and,

a second pixel, the second pixel comprises:

a photodetector that comprises a second region of a second conductivity type in the substrate;

a first region of the first conductivity type being vertically above the second region and under a top interface of the substrate;

a first drain of a first transistor, the first drain abutting the first region;

a first gate of the first transistor, the first gate being vertically above the first and second regions;

a first color filter, the first color filter being a red color filter or a green color filter or a yellow color filter; and,

a first light guide, the first light guide being configured to transmit a light from the first color filter

to the second region via the first gate and the first region.

2. The pixel array of claim 1, wherein the first transistor is a select switch or a reset switch or an output transistor.

3. The pixel array of claim 1, wherein the first transistor is a transfer gate.

4. The pixel array of claim 1, wherein the first light guide uses total internal reflection at its sidewalls to prevent the light from exiting laterally.

5. The pixel array of claim 1, wherein the first gate has a thickness between 200 Angstroms and 1,000 Angstroms.

6. The pixel array of claim 1, wherein the first gate has a thickness between 300 Angstroms and 700 Angstroms.

7. The pixel array of claim 1, wherein the first gate has a thickness within 500 +/- 50 Angstroms.

8. The pixel array of claim 1, wherein the first gate is thinner than a gate of a transistor in an ADC in the image sensor.

9. The pixel array of claim 1, the first pixel comprising:

a second color filter, the second color filter being a blue color filter or a magenta color filter; and,

a second light guide configured to transmit a light from the second color filter to the substrate mostly without passing through a gate of a transistor.

10. The pixel array of claim 1, wherein the first region is not deeper than 0.8um in the substrate where the first color filter is a red color filter, and is not deeper than 0.5um in the substrate if the first color filter is a green color filter or a yellow color filter.

Claims

What is claimed is:

1. A pixel array of an image sensor supported by a substrate of a first conductivity type, comprising: a first pixel configured to detect a blue light; and, a second pixel, the second pixel comprises: a photodetector that comprises a second region of a second conductivity type in the substrate; a first region of the first conductivity type being vertically above the second region and under a top interface of the substrate; a first drain of a first transistor, the first drain abutting the first region; a first gate of the first transistor, the first gate being vertically above the first and second regions; a first color filter, the first color filter being a red color filter or a green color filter or a yellow color filter; and, a first light guide, the first light guide being configured to transmit a light from the first color filter to the second region via the first gate and the first region.

2. The pixel array of claim 1, wherein the first transistor is a select switch or a reset switch or an output transistor.

3. The pixel array of claim 1, wherein the first transistor is a transfer gate.

4. The pixel array of claim 1, wherein the first light guide uses total internal reflection at its sidewalls to prevent the light from exiting laterally.

5. The pixel array of claim 1, wherein the first gate has a thickness between 200 Angstroms and 1,000 Angstroms.

6. The pixel array of claim 1, wherein the first gate has a thickness between 300 Angstroms and 700 Angstroms.

7. The pixel array of claim 1, wherein the first gate has a thickness within 500+/-50 Angstroms.

8. The pixel array of claim 1, wherein the first gate is thinner than a gate of a transistor in an analog-to-digital converter in the image sensor.

9. The pixel array of claim 1, the first pixel comprising: a second color filter, the second color filter being a blue color filter or a magenta color filter; and, a second light guide configured to transmit a light from the second color filter to the substrate mostly without passing through a gate of a transistor.

10. The pixel array of claim 1, wherein the first region is not deeper than 0.8 um in the substrate where the first color filter is a red color filter, and is not deeper than 0.5 um in the substrate if the first color filter is a green color filter or a yellow color filter.

11. The pixel array of claim 1, wherein the first region is not deeper than 0.5 um in the substrate where the first color filter is a red color filter, and is not deeper than 0.35 um in the substrate if the first color filter is a green color filter or a yellow color filter.

12. The pixel array of claim 1, wherein the first conductivity type is p-type and the second conductivity type is n-type.

13. A method for forming a pixel array of an image sensor supported by a substrate of a first conductivity type, comprising: forming a second region of a second conductivity type in the substrate; forming a first region of the first conductivity in the substrate and vertically above the second region; forming a drain of a transistor in the substrate, the drain abutting the first region; forming a gate of the transistor above the substrate, the gate being vertically above the first region and adjacent to the drain; forming a color filter, the color filter being a red color filter or a green color filter or a yellow color filter; and, forming a light guide, the light guide being configured to transmit a light from the color filter to the second region via the gate and the first region.

14. The method of claim 13, further comprising: thinning the gate in a dimension perpendicular to the substrate.

15. The method of claim 14, wherein, after the thinning, the gate has a thickness between 200 Angstroms and 1,000 Angstroms.

16. The method of claim 14, wherein, after the thinning, the gate has a thickness between 300 Angstroms and 700 Angstroms.

17. The method of claim 14, wherein after the thinning the gate has a thickness within 500+/-50 Angstroms.

18. The method of claim 14, wherein the gate is thinned by an etching in which an etchant is introduce through an opening through an insulation film over the gate, the light guide being subsequently formed in the opening.

19. The method of claim 18, further comprising: forming an anti-reflection stack in the opening after the thinning and before forming the light guide.

20. The method of claim 14, wherein the thinning is performed through a wet etch.

21. The method of claim 18, wherein the opening is opened with a plasma etch first then followed by a wet etch.

22. The method of claim 13, wherein the first conductivity type is p-type, and the second conductivity type is n-type.

23. The pixel array of claim 1, wherein the first light guide is disposed on the first gate.

24. The pixel array of claim 1, wherein the substrate is covered by an insulating film and the light guide is embedded in the insulating film.