CLAIMS

What is claimed is:

1. An image sensor comprising a pixel array that comprises a plurality of pixels, each pixel comprising:

a photoelectric conversion unit below an insulating layer; and,

a light guide, said light guide being embedded in the insulating layer and between a plurality of wires, also embedded in the insulating layer, to transmit light to said photoelectric conversion unit, a horizontal spacing between said light guides of each pair of consecutive pixels among five or more pixels that are arrayed side-by-side in a direction and that are among the plurality of pixels alternates between increasing and decreasing across the five or more pixels.

2. The image sensor of claim 1, said each pixel further comprising:

a color filter coupled to transmit light to said photoelectric conversion unit via said light guide, there being a gap between said color filters of each pair of consecutive pixels among the five or more pixels, the gap

having a width that alternates between increasing and decreasing across the five or more pixels.

3. The image sensor of claim 2, said each pixel further comprising:

a color filter coupled to transmit light to said photoelectric conversion unit via said light guide, there being a gap between said color filters of each pair of consecutive pixels among the five or more pixels, a gap pitch not varying by more than 0.1□m across the five or more pixels, the gap pitch being a horizontal distance between each pair of consecutive centerlines of the gaps.

4. The image sensor of any one of claims 1 to 2, said each pixel further comprising:

a color filter coupled to transmit light to said photoelectric conversion unit via said light guide, there being a gap between said color filters of each pair of consecutive pixels among the five or more pixels, a gap pitch alternates between increasing and decreasing across the five or more pixels, the gap pitch being a horizontal distance between each pair of consecutive centerlines of the gaps.

5. The image sensor of any one of claims 2 to 4, wherein the gap contains air or a gas.

6. The image sensor of any one of claims 2 to 4, wherein the gap contains a liquid or solid material, the liquid or solid material having a refractive index that is at least 20% less than that of the color filter.

7. The image sensor of any one of claims 2 to 4, where the gap has a width not more than 0.45um between said color filters of said each pair of consecutive pixels.

8. The image sensor of claim 1, wherein said light guide has a width that alternates between increasing and decreasing across the five or more pixels.

9. The image sensor of claim 8, wherein the width of said light guide is smaller for a pixel among the five or more pixels that is configured to detect lights of shorter wavelengths only than for another pixel among the five or more pixels that is configured to detect lights of longer wavelengths.

10. The image sensor of claim 8, wherein the width of said light guide is smaller for a blue pixel than for a red pixel.

11. The image sensor of claim 8, wherein the width of said light guide is smaller for a blue pixel than for a green pixel.

12. The image sensor of claim 8, wherein the width of said light guide is smaller for a green pixel than for a red pixel.

13. The image sensor of any one of claims 2 to 7, wherein said color filter comprises a colorant.

14. A method for detecting an image using a solid-state image sensor, comprising:

providing a plurality of photoelectric conversion units below an insulating layer and below a plurality of wires embedded in the insulating layer; and,

providing a plurality of light guides embedded in the insulating layer between the plurality of wires, to transmit light to the photoelectric conversion unit, where a horizontal spacing between the light guides of

each pair of consecutive pixels among five or more pixels that are arrayed side-by-side in a direction and that are among the plurality of pixels alternates between increasing and decreasing across the five or more pixels.

15. The method of claim 14, wherein the image sensor is further characterized by any one of the claims 2 to 13.

CLAIMS

What is claimed is:

1. An image sensor comprising a pixel array that comprises a plurality of pixels, each pixel comprising:

a photoelectric conversion unit below an insulating layer; and,

a light guide, said light guide being embedded in the insulating layer and between a plurality of wires, also embedded in the insulating layer, to transmit light to said photoelectric conversion unit,

wherein bottom widths of light guides of five or more pixels that are arrayed side-by-side in a direction and are among the plurality of pixels vary non-monotonically in said direction,

wherein the bottom width of said light guide is smaller for pixels among the five or more pixels configured to detect lights of shorter wavelengths only than pixels among the five or more pixels configured to detect lights of longer wavelengths.

2. The image sensor of claim 1, wherein said bottom widths alternate between increasing and decreasing across the five or more pixels.

3. The image sensor of claim 1 or 2, wherein the bottom widths alternate between two widths.

4. The image sensor of claim 1, wherein the bottom width of said light guide is smaller for a blue pixel than for a red pixel.

5. The image sensor of claim 1, wherein the bottom width of said light guide is smaller for a blue pixel than for a green pixel.

6. The image sensor of claim 1, wherein the bottom width of said light guide is smaller for a green pixel than for a red pixel.

7. The image sensor of any one of the above claims, wherein a sequence of increase/decrease across the five or more pixels is repeated across the pixel array.