

WHAT IS CLAIMED IS:

1. An image sensor comprising:
 - a semiconductor substrate comprising a pixel region and an optical black region;
 - a plurality of photoelectric conversion regions in the pixel region;
 - a wiring structure on a first surface of the semiconductor substrate;
 - a light shielding layer on a second surface of the semiconductor substrate in the optical black region; and
 - a first light shielding wall structure penetrating the semiconductor substrate between the pixel region and the optical black region, the first light shielding wall structure connected to the light shielding layer,
 - wherein the semiconductor substrate further comprises a dummy pixel region between the pixel region and the optical black region,
 - wherein a color filter and micro-lenses are disposed in the pixel region and in the dummy pixel region, and
 - wherein the first light shielding wall structure is disposed in the dummy pixel region, and completely penetrates the semiconductor substrate.
2. The image sensor according to claim 1, wherein the first light shielding wall structure comprises:
 - an insulation layer in a trench that extends in the semiconductor substrate from the first surface of the semiconductor substrate to the second surface of the semiconductor substrate; and
 - a metal layer on the insulation layer in the trench.
3. The image sensor according to claim 2, wherein the metal layer comprises a same material as the light shielding layer.
4. The image sensor according to claim 2 or claim 3, wherein the insulation layer comprises a portion that is outside of the trench and extends between the light shielding layer and the second surface of the semiconductor substrate.
5. The image sensor according to any one of claims 2 to 4,

wherein the metal layer and the light shielding layer comprise a continuous layer that extends from the trench onto the second surface of the semiconductor substrate,

wherein the trench comprises a first width at a level that is coplanar with the second surface of the semiconductor substrate and a second width at a level that is coplanar with the first surface of the semiconductor substrate, and

wherein the first width is greater than the second width.

6. The image sensor according to any one of claims 1 to 5, wherein the first light shielding wall structure continuously extends from the first surface of the semiconductor substrate to the second surface of the semiconductor substrate.

7. The image sensor according to any one of claims 1 to 6,
wherein the light shielding layer extends onto the dummy pixel region, and
wherein the first light shielding wall structure is vertically overlapped by the light shielding layer.

8. The image sensor according to claim 7,
wherein a first side of the first light shielding wall structure faces the pixel region, and
wherein a second side of the first light shielding wall structure that is opposite to the first side of the first light shielding wall structure faces the optical black region.

9. The image sensor according to any one of claims 1 to 8,
wherein the optical black region extends in a direction parallel to the first surface of the semiconductor substrate and parallel to the pixel region,
wherein the dummy pixel region extends in the direction, between the optical black region and the pixel region, and
wherein the first light shielding wall structure extends in the direction an entire length that the dummy pixel region extends in the direction.

10. The image sensor according to any one of claims 1 to 9, wherein the optical black region and the first light shielding wall structure define a boundary of the pixel region.

11. The image sensor according to any one of claims 1 to 10,

wherein the semiconductor substrate further comprises a peripheral region on at least one side of the optical black region,

wherein the image sensor further comprises a second light shielding wall structure between the optical black region and the peripheral region, and

wherein the second light shielding wall structure penetrates the semiconductor substrate and is connected to the light shielding layer.

12. The image sensor according to claim 11, further comprising:

a conductive pad on the second surface of the semiconductor substrate in the peripheral region;

a through via penetrating the semiconductor substrate in the peripheral region, the through via electrically connected to the conductive pad and the wiring structure; and

a third light shielding wall structure penetrating the semiconductor substrate in the dummy pixel region, the third light shielding wall structure comprising an upper surface that contacts the light shielding layer and a lower surface that is coplanar with a lower surface of the through via.

13. The image sensor according to any one of claims 1 to 12, further comprising:

a device isolation region disposed in a device isolation trench, the device isolation trench partly penetrating the semiconductor substrate.

14. An image sensor comprising:

a semiconductor substrate comprising a pixel region, an optical black region, and a dummy pixel region between the pixel region and the optical black region;

a plurality of photoelectric conversion regions in the pixel region;

a wiring structure on a first surface of the semiconductor substrate;

a light shielding layer on a second surface of the semiconductor substrate in the optical black region; and

at least one first light shielding wall structure in the dummy pixel region, the at least one first light shielding wall structure completely penetrating the semiconductor substrate and connected to the light shielding layer,

wherein a color filter and micro-lenses are disposed in the pixel region and in the dummy pixel region.

15. The image sensor according to claim 14, wherein the at least one first light shielding wall structure comprises:

an insulation layer in a trench in the semiconductor substrate; and

a metal layer on the insulation layer in the trench and integrally connected to the light shielding layer.

16. The image sensor according to claim 14 or claim 15,
wherein the semiconductor substrate further comprises a peripheral region beside the optical black region,

wherein the image sensor further comprises a second light shielding wall structure between the optical black region and the peripheral region,

wherein the optical black region and the peripheral region are free of the plurality of photoelectric conversion regions, and

wherein the second light shielding wall structure penetrates the semiconductor substrate and is connected to the light shielding layer.

17. The image sensor according to claim 16, wherein the at least one first light shielding wall structure and the second light shielding wall structure extend from the first surface of the semiconductor substrate to the second surface of the semiconductor substrate.

18. An image sensor comprising:

a semiconductor substrate comprising a pixel region, an optical black region, and a dummy pixel region between the pixel region and the optical black region;

a plurality of photoelectric conversion regions in the pixel region;

a wiring structure on a first surface of the semiconductor substrate;

a light shielding layer on a second surface of the semiconductor substrate in at least a portion of each of the optical black region and the dummy pixel region; and

a light shielding wall structure in the semiconductor substrate in the dummy pixel region,

wherein the light shielding layer vertically overlaps the light shielding wall structure,

wherein a color filter and micro-lenses are disposed in the pixel region and in the dummy pixel region, and

wherein the light shielding wall structure completely penetrates the semiconductor substrate.

19. The image sensor according to claim 18, wherein the light shielding wall structure comprises:

an insulation layer in a trench that extends in the semiconductor substrate from the first surface of the semiconductor substrate to the second surface of the semiconductor substrate; and

a metal layer on the insulation layer in the trench and comprising a same metal as the light shielding layer.

20. The image sensor according to claim 18 or claim 19, wherein the light shielding wall structure comprises a first width at a level coplanar with the second surface of the semiconductor substrate and a second width at a level coplanar with the first surface of the semiconductor substrate, and

wherein the first width is greater than the second width.

21. The image sensor according to any one of claims 18 to 20, further comprising a metal guide pattern on the second surface of the semiconductor substrate in the pixel region,

wherein opposing first and second sidewalls of the light shielding wall structure extend continuously from the second surface of the semiconductor substrate to the first surface of the semiconductor substrate between the pixel region and the optical black region.