CLAIMS

1. A p-i-n photodetector comprising a dopant diffusion barrier layer disposed within an active light absorbing region of the p-i-n photodetector.

2. The p-i-n photodetector of claim 1 comprising

a first semiconductor layer having a region doped to a first polarity;

a second semiconductor layer having a region doped to a second polarity, the second polarity being opposite to the first polarity, wherein the dopant diffusion barrier layer is disposed between the first semiconductor layer and the second semiconductor layer for reducing doping of the first polarity into the region between the dopant diffusion barrier layer and the second semiconductor layer.

3. The p-i-n photodetector of claim 2, wherein the region doped to the first polarity of the first semiconductor layer has a higher doped portion and wherein the region doped to the second polarity of the second semiconductor layer has a higher doped portion, so that the greater doped portion of the second polarity and the higher doped portion of the first polarity form a pn junction of the p-i-n photodetector.

4. The p-i-n photodetector of any one of the preceding claims, further comprising an intrinsic layer, located so that the dopant diffusion barrier layer is disposed between the first semiconductor layer and the intrinsic layer and the intrinsic layer is disposed between the dopant diffusion barrier layer and the second semiconductor layer.

5. The p-i-n photodetector of claim 3, further comprising an intrinsic layer, located so that the dopant diffusion barrier layer is disposed between the first semiconductor layer and the intrinsic layer, and the intrinsic layer is disposed between the dopant diffusion barrier layer and the second semiconductor layer, wherein the intrinsic layer has a region doped to the first polarity to a concentration less than that of the higher doped portion of the first semiconductor layer due to the presence of the dopant diffusion barrier layer.

6. The p-i-n photodetector of claims 4 or 5, wherein the first semiconductor layer, the dopant diffusion barrier layer and the intrinsic layer are provided as a stack on the second semiconductor layer such that the respective bases of the first

semiconductor layer, the dopant diffusion barrier layer and the intrinsic layer extend to be in contact with a surface of the second semiconductor layer.

7. The p-i-n photodetector of any one of the claims 4 to 6, further comprising a metal layer in contact with each of the higher doped portion of the second polarity and the higher doped portion of the first polarity.

8. The p-i-n photodetector of any one of the preceding claims, wherein the dopant diffusion barrier layer comprises material that is different from the first semiconductor layer.

9. The p-i-n photodetector of any one of the claims 4 to 7, wherein the intrinsic layer comprises material that is the same as that of the first semiconductor layer.

10. The p-i-n photodetector of claims 8 or 9, wherein the first semiconductor layer and the dopant diffusion barrier layer comprise materials from any one or more of Group IV semiconductors, an alloy of Group IV semiconductors and Group III-V semiconductor compounds.

11. The p-i-n photodetector of claim 10, wherein the first semiconductor layer and the dopant diffusion barrier layer respectively comprise a Group IV semiconductor and a Group III-V semiconductor compound pairing, such as germanium and silicon, germanium and a silicon-germanium alloy or a silicon-germanium alloy and silicon.

12. The p-i-n photodetector of any one of the preceding claims, wherein the second semiconductor layer comprises silicon, germanium or a silicon-germanium alloy.

13. The p-i-n photodetector of any one of the claims 3 to 12, wherein the first polarity is from doping the first semiconductor layer with an n-type dopant.

14. The p-i-n photodetector of any one of the claims 3 to 13, wherein the second polarity is from doping the second semiconductor layer with a p-type dopant.

15. A method of fabricating a p-i-n photodetector, the method comprising

providing a first semiconductor layer having a region doped to a first polarity;

providing a second semiconductor layer having a region doped to a second polarity, the second polarity being opposite to the first polarity;

providing a dopant diffusion barrier layer between the first semiconductor layer and the second semiconductor layer; and

doping the first semiconductor layer to a higher doped portion within the region doped to a first polarity, wherein the dopant diffusion barrier layer reduces doping of the first polarity to form an intrinsic layer between the dopant diffusion barrier layer and the second semiconductor layer, so that the dopant diffusion barrier layer is disposed between the first semiconductor layer and the intrinsic layer, and the intrinsic layer is disposed between the dopant diffusion barrier layer and the second semiconductor layer, wherein the intrinsic layer has a region doped to the first polarity to a concentration less than that of the higher doped portion of the first semiconductor layer.

16. The method of claim 15, wherein the intrinsic layer comprises material that is the same as that of the first semiconductor layer.

17. The method of claim 15 or 16, further comprising the steps of:

doping the second semiconductor layer to form a higher doped portion within the region doped to the second polarity; and

providing the first semiconductor layer, the dopant diffusion barrier layer and the intrinsic layer as a stack on the second semiconductor layer.

18. The method of claim 17, further comprising the step of: forming a metal layer in contact with each of the higher doped portion of the second polarity and the higher doped portion of the first polarity.

Claims:

1. A p-i-n photodetector comprising:

a dopant diffusion barrier layer disposed within an active light absorbing region of the p-i-n photodetector, wherein the dopant diffusion barrier layer has a thickness less than 5nm;

a first semiconductor layer having a region doped to a first polarity;

a second semiconductor layer having a region doped to a second polarity, the second polarity being opposite to the first polarity,

wherein the dopant diffusion barrier layer is disposed between the first semiconductor layer and the second semiconductor layer for reducing doping of the first polarity into the region between the dopant diffusion barrier layer and the second semiconductor layer, and

wherein the region doped to the first polarity of the first semiconductor layer has a higher doped portion and wherein the region doped to the second polarity of the second semiconductor layer has a higher doped portion, so that the higher doped portion of the second polarity and the higher doped portion of the first polarity form a pn junction of the p-i-n photodetector.

2. The p-i-n photodetector of claim 1, further comprising an intrinsic layer, located so that the dopant diffusion barrier layer is disposed between the first semiconductor layer and the intrinsic layer and the intrinsic layer is disposed between the dopant diffusion barrier layer and the second semiconductor layer.

3. The p-i-n photodetector of claim 1, further comprising an intrinsic layer, located so that the dopant diffusion barrier layer is disposed between the first semiconductor layer and the intrinsic layer, and the intrinsic layer is disposed between the dopant diffusion barrier layer and the second semiconductor layer, wherein the intrinsic layer has a region doped to the first polarity to a concentration less than that of the higher doped portion of the first semiconductor layer due to the presence of the dopant diffusion barrier layer.

4. The p-i-n photodetector of claim 2, wherein the first semiconductor layer, the dopant diffusion barrier layer and the intrinsic layer are provided as a stack on the second semiconductor layer such that the respective bases of the first semiconductor layer, the dopant diffusion barrier layer and the intrinsic layer extend to be in contact with a surface of the second semiconductor layer.

5. The p-i-n photodetector of claim 2, further comprising a metal layer in contact with each of the higher doped portion of the second polarity and the higher doped portion of the first polarity.

6. The p-i-n photodetector of claim 1, wherein the dopant diffusion barrier layer comprises material that is different from the first semiconductor layer.

7. The p-i-n photodetector of claim 2, wherein the intrinsic layer comprises material that is the same as that of the first semiconductor layer.

8. The p-i-n photodetector of claim 6, wherein the first semiconductor layer and the dopant diffusion barrier layer comprise materials from any one or more of Group IV semiconductors, an alloy of Group IV semiconductors and Group III-V semiconductor compounds.

9. The p-i-n photodetector of claim 8, wherein the first semiconductor layer comprises germanium and the dopant diffusion barrier layer comprises silicon or a silicon-germanium alloy; or wherein the first semiconductor layer comprises a silicon-germanium alloy and the dopant diffusion barrier layer comprises silicon.

10. The p-i-n photodetector of claim 1, wherein the second semiconductor layer comprises silicon, germanium or a silicon-germanium alloy.

11. The p-i-n photodetector of claim 1, wherein the first polarity is from doping the first semiconductor layer with an n-type dopant.

12. The p-i-n photodetector of claim 1, wherein the second polarity is from doping the second semiconductor layer with a p-type dopant.

13. A method of fabricating a p-i-n photodetector, the method comprising:

providing a first semiconductor layer having a region doped to a first polarity;

providing a second semiconductor layer having a region doped to a second polarity, the second polarity being opposite to the first polarity;

providing a dopant diffusion barrier layer between the first semiconductor layer and the second semiconductor layer, the dopant diffusion barrier layer having a thickness of less than 5nm and configured to reduce doping of the first polarity into the region between the dopant diffusion barrier layer and the second semiconductor layer;

doping the first semiconductor layer to a higher doped portion within the region doped to a first polarity;

doping the second semiconductor layer to a higher doped portion within the region doped to a second polarity; and

forming a pn junction of the p-i-n photodetector using the higher doped portion of the second polarity and the higher doped portion of the first polarity.

14. The method of claim 13, wherein the intrinsic layer comprises material that is the same as that of the first semiconductor layer.

15. The method of claim 13, further comprising

providing the first semiconductor layer, the dopant diffusion barrier layer and the intrinsic layer as a stack on the second semiconductor layer.

16. The method of claim 15, further comprising forming a metal layer in contact with each of the higher doped portion of the second polarity and the higher doped portion of the first polarity.

17. The method of claim 13, wherein the dopant diffusion barrier layer reduces doping of the first polarity to form an intrinsic layer between the dopant diffusion barrier layer and the second semiconductor layer, so that the dopant diffusion barrier layer is disposed between the first semiconductor layer and the intrinsic layer, and the intrinsic layer is disposed between the dopant diffusion barrier layer and the second semiconductor layer, wherein the intrinsic layer has a region doped to the first polarity to a concentration less than that of the higher doped portion of the first semiconductor layer.