embodiments, the barrier for the electrons at the interface **204** between the subcells **202** can be lowered by additional doping.

[0050] Referring to FIG. **9**A, a band diagram for one specific example of an InGaN tandem solar cell having the structure of FIG. **7** with compositional grading is illustrated. In this example, the p-InGaN doping is 1×10^{17} cm^{-3} Mg (100 meV activation energy) and the n-InGaN doping is 1×10^{17} cm^{-3} (resonant donor). The $In_xGa_{1-x}N$ layers in the subcells are compositionally graded as follows: x=0.25 to 0.45 from 0-500 nm (upper p-type region); x=0.45 (constant) from 500-1000 nm (upper n-type region); x=0.75 to 0.85 from 1000-1500 nm (lower p-type region); x=0.85 (constant) from 1500-2000 nm (lower n-type region).

[0051] Referring to FIG. **9**B, a band diagram for another specific example of an InGaN tandem solar cell having the structure of FIG. **7** with compositional grading is illustrated. In this example, the p-InGaN doping is 1×10^{17} cm^{-3} Mg (100 meV activation energy) and the n-InGaN doping is 1×10^{17} cm^{-3} (resonant donor). The $In_xGa_{1-x}N$ layers in the subcells are compositionally graded as follows: x=0.25 to 0.5 from 0-500 nm (upper p-type region); x=0.5 to 0.45 from 500-1000 nm (upper n-type region); x=0.65 to 0.85 from 1000-1500 nm (lower p-type region); x=0.85 to 0.75 from 1500-2000 nm (lower n-type region).

[0052] In accordance with one or more embodiments, a tandem solar cell is provided having a low-resistance tunnel junction formed between two solar cells in which one of the solar cells includes a compositionally graded Group III-nitride alloy. One representative example of such a low-resistance tunnel junction in an InGaN/Si tandem solar cell is described in PCT Patent Application Publication No. WO/2008/124160, published on Oct. 16, 2008 entitled, "LOW RESISTANCE TUNNEL JUNCTIONS FOR HIGH EFFICIENCY TANDEM SOLAR CELLS," the contents of which are incorporated herein by reference. In such a tandem solar cell, in accordance with one or more embodiments, either or both of the n-type and p-type regions can be compositionally graded in accordance with the compositionally graded Group III-nitride alloys described herein, such that the grading can be linear or formed in according to another spatial function. In accordance with one or more embodiments, a back surface field can be used in the Si layer to improve charge collection.

[0053] Referring to FIG. **10**A, a band diagram for one specific example of an InGaN/Si tandem solar cell formed with compositional grading and having a low-resistance tunnel junction is illustrated. In this illustrated example, the band diagram was obtained by solving the Poisson equation numerically, the p-InGaN doping is 1×10^{17} cm^{-3} Mg (100 meV activation energy), and the n-InGaN doping is 1×10^{17} cm^{-3} (resonant donor). In the Si layer, p-type and n-type regions are 1×10^{17} (shallow donor/acceptor). The $In_xGa_{1-x}N$ layers in the subcells are compositionally graded as follows: x=0.25 to 0.45 in the p-type region, from 0-500 nm, providing an additional electric field to move the minority carriers (electrons) towards the n-type region (500-1000 nm).

[0054] Referring to FIG. **10**B, a band diagram for another specific example of an InGaN/Si tandem solar cell formed with compositional grading and having a low-resistance tunnel junction is illustrated. In this illustrated example, the band diagram was obtained by solving the Poisson equation numerically, the p-InGaN doping is 1×10^{17} cm^{-3} Mg (100 meV activation energy), and the n-InGaN doping is 1×10^{17} cm^{-3} (resonant donor). In the Si layer, p-type and n-type regions are 1×10^{17} (shallow donor/acceptor). The $In_xGa_{1-x}N$ layers in the subcells are compositionally graded as follows: x=0.25 to 0.5 in the p-type region (0-500 nm) and x=0.5 to 0.55 in the n-type region (500-1000 nm). The grading in the n-type region creates an electric field that sends holes (minority carriers) to the p-type region.

1. A solar cell, comprising:
a layer of a compositionally graded Group III-nitride alloy;
a layer of photovoltaic material;
a single p-n junction between the compositionally graded Group III-nitride alloy layer and the photovoltaic layer; and
a plurality of depletion regions for charge separation associated with the single p-n junction.

2. The solar cell of claim **1**, wherein the Group III-nitride alloy layer comprises $In_xGa_{1-x}N$ that is graded between two portions of the Group III-nitride alloy layer between two values of x, where $0.0\leqq x\leqq 1.0$.

3. The solar cell of claim **2**, wherein the Group III-nitride alloy layer comprises $In_xGa_{1-x}N$, where $0.25\leqq x\leqq 0.45$.

4. The solar cell of claim **1**, wherein the Group III-nitride alloy layer comprises $In_xAl_{1-x}N$ that is graded between two portions of the Group III-nitride alloy layer between two values of x, where $0.0\leqq x\leqq 1.0$.

5. The solar cell of claim **4**, wherein the Group III-nitride alloy layer comprises $In_xAl_{1-x}N$, where $0.6\leqq x\leqq 0.8$.

6. The solar cell of claim **1**, wherein the photovoltaic material comprises a silicon material.

7. The solar cell of claim **1**, wherein the photovoltaic material comprises a compositionally graded Group III-nitride alloy.

8. The solar cell of claim **1**, further comprising:
a first electrical contact coupled to the Group III-nitride alloy layer;
a layer of n+material formed on the layer of photovoltaic material; and
a second electrical contact coupled to the layer of n+material.

9. A solar cell, comprising:
a first junction of a Group III-nitride alloy having a first bandgap; and
a second junction of a Group III-nitride alloy having a second bandgap electrically coupled to the first junction,
wherein at least one of the first and second junctions includes a compositionally graded Group III-nitride alloy.

10. A semiconductor structure, comprising:
a first photovoltaic cell comprising a first material; and
a second photovoltaic cell comprising a second material, the second photovoltaic cell connected in series to the first photovoltaic cell,
wherein at least one of the first material and the second material comprise a compositionally graded Group III-nitride alloy;
wherein a low resistance tunnel junction is formed between the first and second photovoltaic cells.

11. The semiconductor structure of claim **10**, wherein the compositionally graded Group III-nitride alloy comprises $In_xGa_{1-x}N$ that is graded between two portions of the Group III-nitride alloy between two values of x, where $0.0\leqq x\leqq 1.0$.

12. The semiconductor structure of claim **11**, wherein the Group III-nitride alloy layer comprises $In_xGa_{1-x}N$, where $0.25\leqq x\leqq 0.45$.