of at least one, but also including more than one, of a number or list of elements, and, optionally, additional unlisted items. Only terms clearly indicated to the contrary, such as "only one of" or "exactly one of," or, when used in the claims, "consisting of," will refer to the inclusion of exactly one element of a number or list of elements. In general, the term "or" as used herein shall only be interpreted as indicating exclusive alternatives (i.e. "one or the other but not both") when preceded by terms of exclusivity, such as "either," "one of," "only one of," or "exactly one of." "Consisting essentially of," when used in the claims, shall have its ordinary meaning as used in the field of patent law.

As used herein in the specification and in the claims, the phrase "at least one," in reference to a list of one or more elements, should be understood to mean at least one element selected from any one or more of the elements in the list of elements, but not necessarily including at least one of each and every element specifically listed within the list of elements and not excluding any combinations of elements in the list of elements. This definition also allows that elements may optionally be present other than the elements specifically identified within the list of elements to which the phrase "at least one" refers, whether related or unrelated to those elements specifically identified. Thus, as a non-limiting example, "at least one of A and B" (or, equivalently, "at least one of A or B," or, equivalently "at least one of A and/or B") can refer, in one embodiment, to at least one, optionally including more than one, A, with no B present (and optionally including elements other than B); in another embodiment, to at least one, optionally including more than one, B, with no A present (and optionally including elements other than A); in yet another embodiment, to at least one, optionally including more than one, A, and at least one, optionally including more than one, B (and optionally including other elements); etc.

In the claims, as well as in the specification above, all transitional phrases such as "comprising," "including," "carrying," "having," "containing," "involving," "holding," and the like are to be understood to be open-ended, i.e., to mean including but not limited to. Only the transitional phrases "consisting of" and "consisting essentially of" shall be closed or semi-closed transitional phrases, respectively, as set forth in the United States Patent Office Manual of Patent Examining Procedures, Section 2111.03.

CLAIMS

1. A semiconductor structure, comprising:

a substrate comprising silicon; and

a III-nitride material region located over a surface region of the substrate,

a diffusion barrier region between the III-nitride material region and the substrate,

wherein:

the diffusion barrier region comprises at least one of a rare-earth oxide and/or a rare-earth nitride,

the surface region of the substrate comprises a low-conductivity parasitic channel or the substrate is free of a parasitic channel, and

at least a region of the substrate comprises at least one species having a relative atomic mass of less than 5 at a concentration of at least about $10^{19}/cm^3$.

2. The semiconductor structure of claim 1, wherein at least a portion of the surface region of the substrate comprises at least one species having a relative atomic mass of less than 5 at a concentration of at least about $10^{19}/cm^3$.

3. The semiconductor structure of claim 1, wherein the substrate comprises at least a layer having a resistivity of greater than about 10^2 Ohms-cm.

4. The semiconductor structure of claim 1, wherein the substrate is a silicon substrate.

5. The semiconductor structure of claim 4, wherein the substrate is a bulk silicon wafer.

6. The semiconductor structure of claim 1, wherein the III-nitride material region comprises GaN.

7. The semiconductor structure of claim 1, wherein the species having a relative atomic

mass of less than 5 comprises hydrogen and/or helium.

8. The semiconductor structure of claim 1, wherein the species having a relative atomic mass of less than 5 is located within the substrate in a spatially defined pattern.

9. The semiconductor structure of claim 1, wherein the surface region of the substrate comprises a low-conductivity parasitic channel.

10. The semiconductor structure of claim 9, wherein the low-conductivity parasitic channel has a peak free carrier concentration that is less than about $10^{17}/cm^3$.

11. The semiconductor structure of claim 9, wherein the low-conductivity parasitic channel has a total integrated surface region charge of less than about $10^{12}/cm^2$.

12. The semiconductor structure of claim 9, wherein the substrate comprises a bulk region below the surface region, the bulk region having a lower peak free carrier concentration than the surface region.

13. The semiconductor structure of claim 12, wherein the bulk region is doped with a first free carrier type and the surface region is doped with a second free carrier type.

14. The semiconductor structure of claim 12, wherein the peak free carrier concentration in the bulk region is less than about $10^{13}/cm^3$.

15. The semiconductor structure of claim 1, wherein the III-nitride material region comprises a III-nitride nucleation layer.

16. The semiconductor structure of claim 1, wherein the III-nitride material region comprises a III-nitride transition layer.

17. The semiconductor structure of claim 1, wherein the III-nitride material region comprises a III-nitride buffer layer.

18. The semiconductor structure of claim 1, wherein the III-nitride material region comprises a III-nitride device region.