CLAIMS

1. A high-voltage nitride device, comprising:

a silicon substrate;

a nitride epitaxial layer, prepared on the silicon substrate;

~~a nitride nucleation layer prepared on the silicon substrate;~~

~~a nitride buffer layer prepared on the nitride nucleation layer;~~

~~a nitride channel layer prepared on the nitride buffer layer;~~

a source electrode and a drain electrode, both of which are contacted with the nitride epitaxial~~channel~~ layer;

a gate electrode, prepared between the source electrode and the drain electrode; and,

at least one spatial isolation area, formed in a region between the silicon substrate and the nitride epitaxial layer vertically and between the source~~gate~~ electrode and the drain electrode horizontally.

2. The device of Claim 1, wherein the at least one spatial isolation area is formed in a region between the silicon substrate and the nitride epitaxial layer vertically and between the gate electrode and the drain electrode horizontally.

3. The device of Claim 1, wherein the nitride epitaxial layer comprises:

a nitride nucleation layer prepared on the silicon substrate;

a nitride buffer layer prepared on the nitride nucleation layer; and

a nitride channel layer prepared on the nitride buffer layer.

4. The device of Claim 3, wherein both of the source electrode and the drain electrode are contacted with the nitride channel layer.

~~2~~5. The device of Claim 1, wherein the at least one spatial isolation area is filled with filling material.

~~3~~6. The device of Claim ~~2~~5, wherein the filling material is made of any selected from a group consisting of Al2O3, SiO2, SiN, AlN, diamond and combinations thereof.

~~4~~7. The device of Claim 1, wherein the at least one spatial isolation area is formed as any one of a square shape, a trapezoid shape, a shape with an arced edge and a U-shape.

~~5~~8. The device of Claim 1, wherein the inner sidewalls of the at least one spatial isolation area are oxidized to form silicon dioxide.

~~6~~9. The device of Claim 1, further comprising:

an insulating layer, prepared at the bottom of the at least one spatial isolation area and across the whole silicon substrate~~;~~.

10. The device of Claim 9, wherein the insulating layer is made of any selected from a group consisting of nitride, oxide and combination thereof.

~~7~~11. The device of Claim ~~1~~3, the nitride epitaxial layer further comprises:~~further comprising:~~

a nitride barrier layer, prepared on the nitride channel layer;

wherein two-dimensional electron gas with high electron concentration is

formed at the interface between the nitride barrier layer and the nitride channel layer.

~~8~~12. The device of Claim ~~7~~11, further comprising:

a dielectric layer, prepared on the nitride barrier layer.

~~9~~13. The device of Claim ~~8~~12, the dielectric layer is made of any selected from a group consisting of SiN, SiO2, SiON, AL2O3, HfO2, HfALOx and combinations thereof.

~~10~~14. The device of Claim ~~7~~11, the nitride epitaxial layer further comprises~~comprising~~:

a nitride cap layer, prepared on the nitride barrier layer.

~~11~~15. The device of Claim ~~7~~11, further comprising:

an AlN spacer, prepared between the nitride barrier layer and the nitride channel layer.

~~12~~16. The device of Claim 1, further comprising:

an AlGaN back barrier layer, prepared between the nitride buffer layer and the nitride channel layer.

~~13~~17. A manufacturing method of a high-voltage nitride device, comprising:

~~providing a silicon substrate;~~

preparing a nitride epitaxial~~nucleation~~ layer ~~prepared~~ on ~~the~~ a silicon substrate provided;

~~preparing a nitride buffer layer prepared on the nitride nucleation layer;~~

~~preparing a nitride channel layer prepared on the nitride buffer layer;~~

preparing a source electrode and a drain electrode on the nitride epitaxial layer; both of which are contacted with the nitride epitaxial~~channel~~ layer;

preparing a gate electrode between the source electrode and the drain electrode;

forming at least one spatial isolation area in a region between the silicon substrate and the nitride epitaxial layer vertically and between the ~~gate~~ source electrode and the drain electrode horizontally.

18. The method of Claim 17, wherein preparing a nitride epitaxial layer on a silicon substrate provided comprises:

preparing a nitride nucleation layer prepared on the silicon substrate;

preparing a nitride buffer layer prepared on the nitride nucleation layer;

preparing a nitride channel layer prepared on the nitride buffer layer.

~~14~~19. The method of Claim ~~13~~17, wherein forming at least one spatial isolation area in a region between the silicon substrate and the nitride epitaxial layer vertically and between the ~~gate~~ source electrode and the drain electrode horizontally comprises:

implementing a dry etching process and/or a wet corroding process to form the at least one spatial isolation area.

~~15~~20. The method of Claim ~~14~~17, wherein forming at least one spatial isolation area in a region between the silicon substrate and the nitride epitaxial

layer vertically and between the source electrode and the drain electrode horizontally comprises:~~further comprising:~~

forming at least one etched hole, which is located in the nitride epitaxial layer and between the drain electrode and the gate electrode horizontally; and/or,

forming at least one etched hole, which is located in the nitride epitaxial layer outside of the drain electrode horizontally; and/or,

forming at least one etched hole, which is located in the nitride epitaxial layer and between the source electrode and the gate electrode horizontally; and/or,

forming at least one etched hole, which is located in the nitride epitaxial layer outside of the source electrode horizontally; and,

implementing an etching process and/or a wet corrosion process in the at least one etched hole laterally