CLAIMS

1. A method of forming a vertical Schottky diode, the method comprising:

providing an engineered substrate, the engineered substrate comprising:

a polycrystalline ceramic core;

a barrier layer encapsulating the polycrystalline ceramic core;

a bonding layer coupled to the barrier layer; and

a substantially single crystalline silicon layer coupled to the bonding layer;

forming a first epitaxial N-type gallium nitride layer coupled to the substantially single crystalline silicon layer and having a first doping concentration;

forming a second epitaxial N-type gallium nitride layer coupled to the first epitaxial N-type gallium nitride layer and having a second doping concentration that is lower than the first doping concentration;

forming a first edge termination region and a second edge termination region coupled to the second epitaxial N-type gallium nitride layer and separated from each other by a portion of the second epitaxial N-type gallium nitride layer;

forming a Schottky contact coupled to the portion of the second epitaxial N-type gallium nitride layer and to the first edge termination region and the second edge termination region;

removing the engineered substrate to expose a back surface of the first epitaxial N-type gallium nitride layer; and

forming an ohmic contact coupled to the back surface of the first epitaxial N-type gallium nitride layer.

2. The method of claim 1 further comprising forming a metal tab attached to the ohmic contact via a solder.

3. The method of claim 1 wherein the second epitaxial N-type gallium nitride layer has a thickness ranging from about 10 μm to about 25 μm.

4. The method of claim 1 wherein forming the first edge termination region and the second edge termination region comprises ion implanting magnesium (Mg) into a first portion and a second portion of the second epitaxial N-type gallium nitride layer.

5. The method of claim 1 further comprising:

forming a plurality of junction barrier Schottky (JBS) grid regions in the portion of the second epitaxial N-type gallium nitride layer between the first edge termination region and the second edge termination region, wherein the plurality of JBS grid regions is coupled to the Schottky contact.

6. The method of claim 5 wherein forming the plurality of JBS grid regions comprises selective-area doping the portion of the second epitaxial N-type gallium nitride layer by magnesium (Mg) ion implantation.