CLAIMS

1. A substrate for radio frequency (RF) devices comprising:

a polycrystalline ceramic core; and

an interlayer structure comprising:

a first silicon oxide layer coupled to the polycrystalline ceramic core;

a polysilicon layer coupled to the first silicon oxide layer;

a second silicon oxide layer coupled to the polysilicon layer;

a barrier layer coupled to the second silicon oxide layer;

a third silicon oxide layer coupled to the barrier layer; and

a substantially single crystalline silicon layer coupled to the third silicon oxide layer.

2. The substrate of claim 1 wherein the polycrystalline ceramic core comprises aluminum nitride.

3. The substrate of claim 1 wherein a thickness of the third silicon oxide layer is less than about 250 nm.

4. The substrate of claim 1 wherein the polycrystalline ceramic core has a thickness that is less than or equal to about 25 μm.

5. The substrate of claim 1 further comprising:

an epitaxial gallium nitride (GaN) layer coupled to the substantially single crystalline silicon layer; and

a coplanar waveguide formed on the epitaxial GaN layer.

6. The substrate of claim 5 further comprising:

a two-dimensional electron gas (2DEG) inducing layer coupled to the epitaxial GaN layer; and

a field effect transistor (FET) comprising:

a drain coupled to a first region of the 2DEG inducing layer;

a source coupled to a second region of the 2DEG inducing layer;

a gate dielectric layer coupled to a third region of the 2DEG inducing

layer; and

a gate coupled to the gate dielectric layer.

7. The substrate of claim 6 wherein the barrier layer comprises:

a first silicon nitride layer coupled to the second silicon oxide layer;

a metal layer coupled to the first silicon nitride layer; and

a second silicon nitride layer coupled to the metal layer.

8. The substrate of claim 7 further comprising a first via through the epitaxial GaN layer and the 2DEG inducing layer, the first via coupling the source to the metal layer, wherein the metal layer is connected to ground.

9. The substrate of claim 8 wherein the polycrystalline ceramic core comprises an indentation on a surface of the polycrystalline ceramic core opposite to the first silicon oxide layer, the substrate further comprising:

a second via through the polycrystalline ceramic core in a location corresponding to the indentation; and

a backside metal layer coupled to the surface of the polycrystalline ceramic core and filling the second via, wherein the second via connects the source of the FET to the backside metal layer, and wherein the backside metal layer is connected to ground.

10. The substrate of claim 9 wherein a thickness of the polycrystalline ceramic core in the location corresponding to the indentation is less than 10 μm.

11. The substrate of claim 9 wherein a width of the indentation is greater than a width of the FET.

12. A radio frequency (RF) device comprising:

a polycrystalline ceramic core;

an interlayer structure comprising:

a first silicon oxide layer coupled to the polycrystalline ceramic core;

a polysilicon layer coupled to the first silicon oxide layer;

a second silicon oxide layer coupled to the polysilicon layer;

a first silicon nitride layer coupled to the second silicon oxide layer;

a metal layer coupled to the first silicon nitride layer;

a second silicon nitride layer coupled to the metal layer;

a third silicon oxide layer coupled to the second silicon nitride layer; and

a substantially single crystalline silicon layer coupled to the third silicon oxide layer;

an epitaxial gallium nitride (GaN) layer coupled to the substantially single crystalline silicon layer;

a two-dimensional electron gas (2DEG) inducing layer coupled to the epitaxial GaN layer;

a field effect transistors (FET) comprising:

a drain coupled to a first region of the 2DEG inducing layer;

a source coupled to a second region of the 2DEG inducing layer;

a gate dielectric layer coupled to a third region of the 2DEG inducing layer; and

a gate coupled to the gate dielectric layer; and

a first via through the epitaxial GaN layer and the 2DEG inducing layer, the first via coupling the source to the metal layer of the interlayer structure, wherein the metal layer is connected to ground.

13. The RF device of claim 12 further comprising a waveguide coupled to the epitaxial GaN layer.

14. The RF device of claim 12 wherein the third silicon oxide layer has a thickness that is equal to or less than about 250 nm.

15. The RF device of claim 12 wherein the polycrystalline ceramic core has a thickness that is equal to or less than about 25 μm.

16. The RF device of claim 12 wherein the polycrystalline ceramic core comprises an indentation on a surface of the polycrystalline ceramic core opposite to the first silicon oxide layer, the RF device further comprising:

a second via through the polycrystalline ceramic core in a location corresponding to the indentation; and

a backside metal layer coupled to the surface of the polycrystalline ceramic core and filling the second via, wherein the second via connects the source of the FET to the backside metal layer, and wherein the backside metal layer is connected to ground.