CLAIMS

What is claimed is:

1. A package structure, comprising:

a planar core structure comprising a first side and a second side opposite the first side;

an antenna structure disposed on the first side of the planar core structure, the antenna structure comprising

a plurality of first laminated layers, each first laminated layer comprising a first patterned conductive layer formed on a first insulating layer,

an antenna formed on one or more first patterned conductive layers of the first laminated layers, the antenna including at least one L-shaped structure as viewed in a plan view;

an interface structure disposed on the second side of the planar core structure; and

an antenna feed line structure formed in, and routed through, the interface structure and the planar core structure, wherein the antenna feed line structure is not connected to the antenna.

2. The package structure of claim 1, wherein the planar core structure comprises a core substrate formed of an insulating material.

3. The package structure of claim 1, wherein the interface structure comprises a plurality of second laminated layers, each second laminated layer comprising a second patterned conductive layer formed on a second insulating layer.

4. The package structure of claim 1,

wherein the interface structure comprises a plurality of second laminated layers, each second laminated layer including a second patterned conductive layer formed on a second insulating layer, and

wherein a power plane, a ground plane, signal lines, and contact pads are formed on one or more patterned second conductive layers of the plurality of second laminated layers of the interface structure.

5. The package structure of claim 1, wherein the antenna includes four of the L-shaped structures.

6. The package structure of claim 5, wherein the L-shaped structures are arranged in a symmetrical manner with corners of the L-shaped structures facing inward.

7. The package structure of claim 1, further comprising a cage wall structure in the antenna structure, the cage wall surrounding the antenna.

8. The package structure of claim 7, wherein the cage wall structure is electrically connected to the L-shaped structure through a first ground plane layer of the core structure.

9. The package structure of claim 7, wherein the cage wall structure includes a plurality of conductive grounded rings that extend vertically through the antenna structure.

10. The package structure of claim l, further comprising:

a first antenna feed line structure and a second antenna feed line structure;

a first bridge formed on one of the one or more first patterned conductive layers and connected to the first antenna feed line structure; and

a second bridge formed on a different one of the one or more first patterned conductive layers and connected to the second antenna feed line structure,

wherein the first bridge and second bridge cross each other in a central portion of the package structure.

11. An apparatus, comprising:

a package structure comprising

a planar core structure comprising a first side and a second side opposite the first side,

an antenna structure disposed on the first side of the planar core structure, the antenna structure comprising

a plurality of first laminated layers, each first laminated layer comprising a first patterned conductive layer formed on a first insulating layer,

an antenna formed on one or more first patterned conductive layers of the first laminated layers, the antenna including at least one L-shaped structure as viewed in a plan view,

an interface structure disposed on the second side of the planar core structure, and

an antenna feed line structure formed in, and routed through, the interface structure and the planar core structure, wherein the antenna feed line structure is not connected to the antenna; and

an RFIC (radio frequency integrated circuit) chip comprising a semiconductor substrate having an active surface and an inactive surface, and a BEOL (back end of line) structure formed

on the active surface of the semiconductor substrate, wherein the RFIC chip is mounted to the package structure by connecting the BEOL structure of the RFIC chip to contact pads of the interface structure.

12. The apparatus of claim 11, wherein the planar core structure comprises a core substrate formed of an insulating material.

13. The apparatus of claim 11, wherein the interface structure comprises a plurality of second laminated layers, each second laminated layer comprising a second patterned conductive layer formed on a second insulating layer.

14. The apparatus of claim 11,

wherein the interface structure comprises a plurality of second laminated layers, each second laminated layer including a second patterned conductive layer formed on a second insulating layer, and

wherein a power plane, a ground plane, signal lines, and contact pads are formed on one or more patterned second conductive layers of the plurality of second laminated layers of the interface structure.

15. The apparatus of claim 11, wherein the antenna includes four of the L-shaped structures.

16. The apparatus of claim 15, wherein the L-shaped structures are arranged in a symmetrical manner with corners of the L-shaped structures facing inward.

17. The apparatus of claim 11, further comprising a cage wall structure in the antenna structure, the cage wall surrounding the antenna.

18. The apparatus of claim 17, wherein the cage wall structure is electrically connected to the L-shaped structure through a first ground plane layer of the core structure.

19. The apparatus of claim 17, wherein the cage wall structure includes a plurality of conductive grounded rings that extend vertically through the antenna structure.

20. The apparatus of claim l1, further comprising:

a first antenna feed line structure and a second antenna feed line structure;

a first bridge formed on one of the one or more first patterned conductive layers and connected to the first antenna feed line structure; and

a second bridge formed on a different one of the one or more first patterned conductive layers and connected to the second antenna feed line structure,

wherein the first bridge and second bridge cross each other in a central portion of the package structure.

21. A method of manufacturing a package structure, the method comprising:

forming a planar core structure comprising a first side and a second side opposite the first side;

forming an antenna structure on the first side of the planar core structure, the antenna structure comprising

a plurality of first laminated layers, each first laminated layer comprising a first patterned conductive layer formed on a first insulating layer,

an antenna formed on one or more first patterned conductive layers of the first laminated layers, the antenna including at least one L-shaped structure as viewed in a plan view;

forming an interface structure on the second side of the planar core structure; and

forming an antenna feed line structure in, and routed through, the interface structure and the planar core structure, wherein the antenna feed line structure is not connected to the antenna.

22. The method of claim 21, wherein the antenna includes four of the L-shaped structures.

23. The method of claim 22, wherein the L-shaped structures are arranged in a symmetrical manner with corners of the L-shaped structures facing inward.

24. The method of claim 21, further comprising forming a cage wall structure in the antenna structure, the cage wall surrounding the antenna.

25. The method of claim 24, wherein the cage wall structure is electrically connected to the L-shaped structure through a first ground plane layer of the core structure.