

CLAIMS

1. A semiconductor package comprising:
 - a substrate comprising a via hole extending from a first surface of the substrate to a second surface of the substrate opposite the first surface;
 - a chip attached to the substrate;
 - a prefabricated ferromagnetic pin having a first portion held by the via hole, a second portion extending out from the via hole at the first surface of the substrate, and a third portion extending out from the via hole at the second surface of the substrate;
 - a first magnetic shield structure attached to or extended from the second portion of the prefabricated ferromagnetic pin; and
 - a second magnetic shield structure attached to or extended from the third portion of the prefabricated ferromagnetic pin, such that at least a portion of the chip is between the first magnetic shield structure and the second magnetic shield structure.
2. The semiconductor package according to claim 1,
 - wherein the prefabricated ferromagnetic pin comprises a non-ferromagnetic plating layer.
3. The semiconductor package according to claim 1, further comprising:
 - a plating layer on an inner wall of the via hole.
4. The semiconductor package according to claim 3,
 - wherein the plating layer comprises an electrically conductive non-ferromagnetic material.
5. The semiconductor package according to claim 3, further comprising:
 - an electrical line in electrical connection with the plating layer;
 - wherein the electrical line is a ground line or a power line.
6. The semiconductor package according to claim 1, further comprising:
 - a first amount of a ferromagnetic epoxy between the first portion of the prefabricated ferromagnetic pin and the first magnetic shield structure for attaching the first magnetic shield structure to the prefabricated ferromagnetic pin; and

a second amount of the ferromagnetic epoxy between the third portion of the prefabricated ferromagnetic pin and the second magnetic shield structure for attaching the second magnetic shield structure to the prefabricated ferromagnetic pin.

7. The semiconductor package according to claim 1,
wherein the substrate comprises one or more further via holes; and
wherein the semiconductor device comprises:
 one or more further first magnetic shield structures; and
 one or more further prefabricated ferromagnetic pins, each of the one or more further prefabricated ferromagnetic pins having a first portion held by a respective further via hole of the one or more further via holes and a second portion extending out from the respective further via hole at the first surface of the substrate, the second portion attached to or extended from a respective further first magnetic shield structure of the one or more further first magnetic shield structures.
8. The semiconductor package according to claim 7, further comprising:
 an encapsulation layer comprising a mold compound; wherein a part of each of the prefabricated ferromagnetic pin and the one or more further prefabricated ferromagnetic pins is embedded in the mold compound.
9. The semiconductor package according to claim 8,
 wherein the encapsulation layer is between the substrate and the first magnetic shield structure.
10. The semiconductor package according to claim 7,
 wherein the via holes and the one or more further via holes form a staggered arrangement.
11. The semiconductor package according to claim 7,
 wherein the prefabricated ferromagnetic pin and the one or more further prefabricated ferromagnetic pins form a plurality of ferromagnetic pins.
12. The semiconductor package according to claim 7, further comprising:
 an insulating layer between the first magnetic shield structure and one further first magnetic shield structure of the one or more further first magnetic shield structures such that the first

magnetic shield structure, the insulating layer, and the one further first magnetic shield structure form a capacitor.

13. The semiconductor package according to claim 12,
wherein the insulator layer comprises a high-dielectric (high- κ) material.
14. The semiconductor package according to claim 1,
wherein the first magnetic shield structure or the second magnetic shield structure forms a heat spreader.
15. The semiconductor package according to claim 1,
wherein the chip comprises a magnetic random access memory (MRAM) device.
16. A method of forming a semiconductor package, the method comprising:
attaching a chip to a substrate comprising a via hole extending from a first surface of the substrate to a second surface of the substrate opposite the first surface;
inserting a first portion of a prefabricated ferromagnetic pin into a via hole so that the first portion is held by the via hole, with a second portion of the prefabricated ferromagnetic pin extending out from the via hole at the first surface of the substrate, and a third portion of the prefabricated ferromagnetic pin extending out from the via hole at the second surface of the substrate;
wherein the semiconductor package further comprises a first magnetic shield structure attached to or extended from the second portion of the prefabricated ferromagnetic pin;
and
wherein the semiconductor package also comprises a second magnetic shield structure attached to or extended from the third portion of the prefabricated ferromagnetic pin, such that at least a portion of the chip is between the first magnetic shield structure and the second magnetic shield structure.
17. The method according to claim 16,
wherein the substrate comprises a plating layer on an inner wall of the via hole forming a plated via hole.
18. The method according to claim 16, further comprising:

encapsulating a plurality of ferromagnetic pins comprising the prefabricated ferromagnetic pin and one or more further prefabricated ferromagnetic pins with a mold compound so that a part of each of the plurality of ferromagnetic pins is embedded in the mold compound; and
inserting the plurality of ferromagnetic pins into a plurality of via holes comprising the via hole and one or more further via holes on the substrate after encapsulating the plurality of ferromagnetic pins with the mold compound.

19. The method according to claim 16, further comprising:

inserting a first portion of a further prefabricated ferromagnetic pin into a further via hole so that the first portion is held by the further via hole, with a second portion of the further prefabricated ferromagnetic pin extending out from the further via hole at the first surface of the substrate, and a third portion of the further prefabricated ferromagnetic pin extending out from the further via hole at the second surface of the substrate,
wherein a further first magnetic shield structure is attached to or extended from the second portion of the further prefabricated ferromagnetic pin; and
forming an insulator layer between the first magnetic shield structure and the further magnetic shield structure to form a capacitor.

20. The method according to claim 16,

wherein the first magnetic structure and the prefabricated ferromagnetic pin are prefabricated as a whole.