## CLAIMS

1. A method of manufacturing a double magnetic tunnel junction device, the method comprising:

forming a first magnetic tunnel junction stack on a back end of line base layer;

forming a spin conducting layer on the first magnetic tunnel junction stack; and

forming a second magnetic tunnel junction stack on the spin conducting layer, the second magnetic tunnel junction stack having a width that is greater than a width of the first magnetic tunnel junction stack.

2. The method according to claim 1, wherein the first magnetic tunnel junction stack is formed on a back end of line base, the spin conducting layer and the second magnetic tunnel junction stack are aligned with each other in a vertical direction.

2. The method according to claim 1,3. The method according to claim 1,

wherein the first magnetic tunnel junction stack includes a first reference layer, a first tunnel barrier layer, and a first magnetic free layer, and

wherein the second magnetic tunnel junction stack includes a second reference layer, a second tunnel barrier layer, and a second magnetic free layer.

4. 3. The method according to claim 1, wherein, after forming the spin conducting layer, the method further comprises:

forming a first dielectric layer on sides of the first magnetic tunnel junction stack and on sides of the spin conducting layer; and

forming a second spin conducting layer on the spin conducting layer, the second spin conducting layer having a width that is greater than a width of the spin conducting layer and greater than the width of the first magnetic tunnel junction stack.

5. 4. The method according to claim 43, wherein the second spin conducting layer is formed in direct contact with the spin conducting layer, and wherein the second spin conducting layer has a same material composition as the spin conducting layer.

6. 5. The method according to claim 43, wherein, after forming the spin conducting layer, the method further comprises:

forming a first dielectric layer on the sides of the first magnetic tunnel junction stack and on the sides of the spin conducting layer;

forming a second spin conducting layer on the spin conducting layer and the first dielectric layer,

forming the second magnetic tunnel junction stack on the second spin conducting layer;

forming a metal etch-stop layer on the second magnetic tunnel junction stack;

forming a metal hardmask layer on the metal etch-stop layer; and

etching through the metal etch-stop layer, the second magnetic tunnel junction stack, the second spin conducting layer, and a portion of a thickness of the first dielectric layer,

wherein the second spin conducting layer has a width that is the same as the width of the second magnetic tunnel junction stack.

7. 6. The method according to claim 43, further comprising pre-treating exposed surfaces with at least one selected from the group consisting of plasma $O_2$, $H_2$, $N_2$ and $NH_3$ prior to forming the second spin conducting layer.

8. 7. The method according to claim 1, wherein the spin conducting layer comprises at least one non-magnetic material selected from the group consisting of Cu, CuN, Ag and AgSn.

9. 8. The method according to claim 1, further comprising forming a dielectric encapsulation layer on the second magnetic tunnel junction stack.

10. 9. The method according to claim 98, wherein the dielectric encapsulation layer comprises at least one selected from the group consisting of PVD, ALD, PECVD, AlOx, $TiO_x$, BN, SiN and SiBCN.

11. 10. A double magnetic tunnel junction device comprising:

a first magnetic tunnel junction stack formed on a back end of line base layer;

a spin conducting layer on the first magnetic tunnel junction stack; and

a second magnetic tunnel junction stack on the spin conducting layer, the second magnetic tunnel junction stack having a width that is greater than a width of the first magnetic tunnel junction stack.,

12. wherein the first magnetic tunnel junction stack, the spin conducting layer and the second magnetic tunnel junction stack are aligned with each other in a vertical direction.

11. The double magnetic tunnel junction device according to claim ~~11, wherein the first magnetic tunnel junction stack is on a back end of line base layer.~~

~~13. The double magnetic tunnel junction device according to claim 12~~10, further comprising a seed layer between the back end of line base layer and the first magnetic tunnel junction stack.

~~14.~~ 12. The double magnetic tunnel junction device according to claim ~~11,~~ 10,

~~wherein~~ the first magnetic tunnel junction stack includes a first reference layer, a first tunnel barrier layer, and a first magnetic free layer, and

~~wherein~~ the second magnetic tunnel junction stack includes a second reference layer, a second tunnel barrier layer, and a second magnetic free layer.

~~15.~~ 13. The double magnetic tunnel junction device according to claim ~~11~~10, further comprising:

~~a~~ a first dielectric layer on sides of the first magnetic tunnel junction stack and on sides of the spin conducting layer; and

~~a~~ a second spin conducting layer on the spin conducting layer, the second spin conducting layer having a width that is greater than a width of the spin conducting layer and greater than the width of the first magnetic tunnel junction stack.

~~16.~~ 14. The double magnetic tunnel junction device according to claim ~~15~~13, wherein the second spin conducting layer is in direct contact with the spin conducting layer, and wherein the second spin conducting layer has a same material composition as the spin conducting layer.

~~17.~~ 15. The double magnetic tunnel junction device according to claim ~~15~~13, further comprising:

~~a~~ a first dielectric layer on the sides of the first magnetic tunnel junction stack and on the sides of the spin conducting layer;

~~a~~ a second spin conducting layer on the spin conducting layer, the second magnetic tunnel junction stack formed on the second spin conducting layer;

~~a~~ a metal etch stop layer on the second magnetic tunnel junction stack; and

~~a~~ a metal hardmask layer on the metal etch stop layer,

~~wherein~~ the second spin conducting layer has a width that is the same as the width of the second magnetic tunnel junction stack.

~~18.~~ 16. The double magnetic tunnel junction device according to claim ~~11~~10, wherein the spin conducting layer comprises at least one non-magnetic material selected from the group consisting of Cu, CuN, Ag and AgSn.

~~19.~~ 17. The double magnetic tunnel junction device according to claim ~~11~~10, further comprising a dielectric encapsulation layer on the second magnetic tunnel junction stack.

~~20.~~ 18. The double magnetic tunnel junction device according to claim ~~19~~17, wherein the dielectric encapsulation layer comprises at least one selected from the group consisting of ~~PVD, ALD, PECVD,~~ AlOx, $TiO_x$, BN, SiN and SiBCN.