CLAIMS

1. A magnetic tunnel junction film stack, comprising:

a buffer layer;

a seed layer disposed over the buffer layer;

a first pinning layer disposed over the seed layer;

a synthetic ferrimagnet (SyF) coupling layer disposed over the first pinning layer;

a second pinning layer disposed over the SyF coupling layer;

a structure blocking layer disposed over the second pinning layer;

a magnetic reference layer disposed over the structure blocking layer;

a tunnel barrier layer disposed over the magnetic reference layer;

a magnetic storage layer disposed over the tunnel barrier layer;

a capping layer disposed over the magnetic storage layer, wherein the capping layer comprises an Fe containing oxide material layer.

2. The film stack of claim 1, wherein the capping layer further comprises:

one or more of an Ir containing layer, a Ru containing layer, or a combination thereof.

3. The film stack of claim 1, wherein the Fe containing oxide material layer is a material selected from the group consisting of a CoFe oxide material, a CoFeB oxide material, a NiFe oxide material, an FeB oxide material, and combinations thereof.

4. The film stack of claim 3, wherein the Fe containing oxide material layer is disposed on and in contact with the magnetic storage layer.

5. The film stack of claim 3, wherein the capping layer further comprises:

a Ta containing layer.

6. The film stack of claim 4, wherein the capping layer comprises:

an Ir containing layer, a Ru containing layer, or a combination thereof is disposed on and in contact with the Fe containing oxide material layer.

7. The film stack of claim 1, wherein the Fe containing oxide material layer has a thickness of between about 2Å and about 10Å.

8. The film stack of claim 1, wherein the SyF coupling layer comprises:
an Ir containing layer.

9. The film stack of claim 1, wherein the buffer layer comprises:
a CoFeB containing layer.

10. The film stack of claim 9, wherein the wt% of boron in the buffer layer is between about 20 wt% and 40 wt%.

11. The film stack of claim 1, wherein the seed layer comprises:
(a) a NiCr containing layer, or (b) one or more of a Pt containing layer, an Ir containing layer, and a Ru containing layer.

12. The film stack of claim 11, wherein:
the seed layer comprises a NiCr containing layer; and
the buffer layer further comprises one or more of a TaN containing layer and a Ta containing layer, wherein the CoFeB containing layer of the buffer layer is disposed over one or more of the TaN containing layer of the buffer layer and the Ta containing layer of the buffer layer.

13. The film stack of claim 9, wherein
the seed layer comprises one or more of a Pt containing layer, an Ir containing layer, and a Ru containing layer; and
the buffer layer further comprises one or more of a TaN containing layer and a Ta containing layer, wherein the CoFeB containing layer of the buffer layer is disposed

under one or more of the TaN containing layer of the buffer layer and the Ta containing layer of the buffer layer.

14. A magnetic tunnel junction film stack, comprising:

a buffer layer, wherein the buffer layer comprises a CoFeB containing layer;

a seed layer disposed over the buffer layer;

a first pinning layer disposed over the seed layer;

a synthetic ferrimagnet (SyF) coupling layer disposed over the first pinning layer, wherein the SyF coupling layer comprises an Ir containing layer;

a second pinning layer disposed over the SyF coupling layer;

a structure blocking layer disposed over the second pinning layer;

a magnetic reference layer disposed over the structure blocking layer;

a tunnel barrier layer disposed over the magnetic reference layer;

a magnetic storage layer disposed over the tunnel barrier layer;

a capping layer disposed over the magnetic storage layer, wherein the capping layer comprises an Fe containing oxide material layer; and

a hard mask disposed over the capping layer.

15. The film stack of claim 14, wherein the Fe containing oxide material layer is disposed on and in contact with the magnetic storage layer.

16. The film stack of claim 15, wherein the Fe containing oxide material layer is a material selected from the group consisting of a CoFe oxide material, a CoFeB oxide material, a NiFe oxide material, an FeB oxide material, and combinations thereof.

17. The film stack of claim 14, wherein an Ir containing layer, a Ru containing layer, or a combination thereof is disposed on and in contact with the Fe containing oxide material layer.

18. A magnetic tunnel junction film stack, comprising:

a buffer layer;

a seed layer disposed on and in contact with the buffer layer;

a first pinning layer disposed on and in contact with the seed layer;

a synthetic ferrimagnet (SyF) coupling layer disposed on and in contact with the first pinning layer;

a second pinning layer disposed on and in contact with the SyF coupling layer;

a structure blocking layer disposed on and in contact with the second pinning layer;

a magnetic reference layer disposed on and in contact with the structure blocking layer;

a tunnel barrier layer disposed on and in contact with the magnetic reference layer;

a magnetic storage layer disposed on and in contact with the tunnel barrier layer;

a capping layer disposed on and in contact with the magnetic storage layer, wherein the capping layer comprises an Fe containing oxide material layer; and

a hard mask disposed on and in contact with the capping layer.

19. The film stack of claim 18, wherein the Fe containing oxide material layer is a material selected from the group consisting of a CoFe oxide material, a CoFeB oxide material, a NiFe oxide material, an FeB oxide material, and combinations thereof.

20. The film stack of claim 18, wherein an Ir containing layer, a Ru containing layer, or a combination thereof is disposed on and in contact with the Fe containing oxide material layer.