

CLAIMS

We claim:

1. A medium comprising:
 - a first soft magnetic layer with a first magnetic thickness (B_{st}), wherein the first underlayer structure has a low magnetic permeability region and a high permeability region;
 - a second soft magnetic layer with a second magnetic thickness; wherein the second magnetic thickness is different from the first magnetic thickness and equal to a magnetic thickness of the low magnetic permeability region; and
 - a first coupling layer disposed between the first soft magnetic layer and the second soft magnetic layer and the first coupling layer configured to antiferromagnetically couple the first soft magnetic layer and the second soft magnetic layer,wherein at least one of the first and second soft magnetic layers comprises amorphous material.
2. The medium of claim 1, wherein the first and second soft magnetic layers comprise amorphous material.
3. The medium of claim 1, wherein the first coupling layer comprises ruthenium.
4. The medium of claim 1, wherein the low magnetic permeability region overlies the high magnetic permeability region.
5. The medium of claim 1, wherein the high magnetic permeability region overlies the low magnetic permeability region.
6. The medium of claim 1, wherein the low magnetic permeability region and the second soft magnetic layer are each oriented adjacent the first coupling layer.

7. The medium of claim 1, wherein the first soft magnetic layer and the second soft magnetic layer have unequal thicknesses.
8. The medium of claim 1, wherein the first soft magnetic layer and the second soft magnetic layer have equal magnetic moments.
9. The medium of claim 1, further comprising:
 - a third soft magnetic layer with a third magnetic thickness, wherein the third magnetic thickness has a different magnitude than one or both of the first magnetic thickness and the second magnetic thickness; and
 - a nonmagnetic spacer layer disposed between the third soft magnetic layer and the first soft magnetic layer.
10. The medium of claim 9, wherein the third soft magnetic layer has higher permeability than each of the first soft magnetic layer and the second soft magnetic layer.
11. The medium of claim 9, further comprising:
 - a fourth soft magnetic layer with a fourth magnetic thickness, wherein the fourth magnetic thickness has a different magnitude than the third magnetic thickness; and
 - a second coupling layer disposed between the third soft magnetic layer and the fourth soft magnetic layer and providing antiferromagnetic coupling between the third soft magnetic layer and the fourth soft magnetic layer.
12. The medium of claim 11, wherein the third and fourth soft magnetic layers have lower permeability than each of the first soft magnetic layer and the second soft magnetic layer.
13. The medium of claim 1, wherein the second soft magnetic layer has the same thickness as the low permeability region.

14. The medium of claim 1, further comprising:
a seed layer overlying the first soft magnetic layer, the second soft magnetic layer, and the first coupling layer;
an interlayer overlying the seed layer; and
a magnetic recording layer overlying the interlayer.
15. The medium of claim 14, wherein the magnetic recording layer is a magnetically hard perpendicular recording layer.
16. The medium of claim 4, where the second soft magnetic layer has a thickness that is 37.5 percentage or less of the total thickness of the first and second soft magnetic layers.
17. The medium of claim 1, wherein the first soft magnetic layer has a higher permeability than the second soft magnetic layer.
18. The medium of claim 5, wherein the first soft magnetic layer has a thickness that is more than 56.25 percentage and 62.5 percentage or less of the total thickness of the first and second soft magnetic layers.