
CLAIMS

1. A stack, comprising:
 - a substrate;
 - a magnetic recording layer; and
 - a TiN-X layer disposed between the substrate and the magnetic recording layer,
 wherein X is a dopant, the TiN-X layer comprising at least about 60% TiN by volume and wherein X is either TiO_x in an amount greater than 0% and less than or equal to about 40% by volume or X is ZrO_x in an amount greater than 0% and less than or equal to about 30% by volume.
- ~~2. The stack of claim 1, wherein X comprises at least one of MgO, TiO, TiO_2 , ZrN, ZrO, ZrO_2 , HfN, HfO, AlN, and Al_2O_3 .~~
- ~~3~~2. The stack of claim 1, wherein the magnetic recording layer comprises:
 - magnetic crystalline grains comprising at least one of FePt, FeXPt alloy, FePd, FeXPd, Co_3Pt ; and
 - a non-magnetic segregant disposed between the crystalline grains and comprising at least one of an oxide, nitride, boride, and carbide material.
- ~~4~~3. The stack of claim 1, wherein X is TiO_2 and X is present in the TiN-X layer in an amount greater than 0 and less than or equal to about 40 vol. %.
- ~~5~~4. The stack of claim 1, wherein X is ~~ZnO₂~~ZrO₂ and X is present in the TiN-X layer in an amount greater than 0 and less than or equal to about 30 vol. %.
- ~~6~~5. The stack of claim 1, wherein:
 - X comprises TiO_2 ; and
 - the magnetic recording layer comprises magnetic crystalline grains and non-magnetic segregant disposed between the crystalline grains and the crystalline grains have an average diameter in the plane of the magnetic layer that is less than about 8.5 nm.

-
- ~~7~~6. The stack of claim 1, wherein:
X comprises ~~ZnO~~₂~~ZrO~~₂; and
the magnetic recording layer comprises magnetic crystalline grains and non-magnetic segregant disposed between the crystalline grains and the crystalline grains have an average diameter in the plane of the magnetic layer that is less than about 6 nm.
- ~~8~~7. The stack of claim 1, wherein the magnetic recording layer comprises magnetic crystalline grains of FePt and a non-magnetic segregant comprising SiO_x and C disposed between the crystalline grains, the magnetic layer comprising SiO_x in an amount between about 35 and about 45 vol. % and C in an amount of about 20 vol. %.
- ~~9~~8. The stack of claim 1, wherein a thickness of the TiN-X layer less than about 30 nm.
- ~~10~~9. The stack of claim 1, further comprising a soft magnetic underlayer comprising one or more of CrRu and MgO, wherein the TiN-X layer is disposed on the soft magnetic underlayer.
- ~~11~~10. The stack of claim ~~10~~9, wherein a thickness of the TiN-X layer is between about 5 nm and about 10 nm.
- ~~12~~11. The stack of claim 1, wherein X is TiO₂ and the TiN-X layer comprises TiO_{0.45}N_{0.55}.
- ~~13~~12. The stack of claim 1, further comprising an undoped TiN layer arranged between the substrate and the TiN-X layer.
- ~~14~~13. The stack of claim ~~13~~12, wherein heat conduction through the TiN-X layer normal to the stack surface is greater than lateral heat conduction in the TiN-X layer.
- ~~15~~14. The stack of claim 1, wherein an amount of X in the TiN-X layer varies in a direction normal to the stack surface.

~~16~~15. The stack of claim ~~15~~14, wherein the TiN-X layer comprises $\text{TiO}_y\text{N}_{1-y}$, wherein y varies in a direction normal to a surface of the stack.

~~17~~16. The stack of claim ~~15~~14, wherein the TiN-X layer comprises $\text{ZrTiO}_y\text{N}_{1-y}$, wherein y varies in a direction normal to a surface of the stack.

~~18~~17. A method, comprising:

forming a TiN-X layer by co-depositing TiN and X, wherein X comprises one of at least one of ~~TiO_x and ZrO_x, MgO, TiO, TiO₂, ZrN, ZrO, ZrO₂, HfN, HfO, AlN and Al₂O₃~~;

and

epitaxially growing an FePt magnetic layer on the TiN-X layer, the TiN-X layer comprising at least about 60% TiN by volume and wherein X is present in the TiN-X in an amount greater than 0% and less than or equal to about 40% by volume.

~~19. — The method of claim 18, wherein an amount of X is greater than 0 and less than about 40 vol. %~~

~~20~~18. The method of claim ~~18~~17, further comprising forming a soft magnetic underlayer, wherein the TiN-X layer is grown on a soft magnetic underlayer.

~~24~~19. The method of claim ~~18~~17, wherein the soft magnetic underlayer comprises one or more of CrRu and MgO.

~~22~~20. The method of claim ~~18~~17, further comprising forming a TiN layer, wherein the TiN-X layer is formed on the TiN layer.