What is claimed is:

1. A method of forming a magnetic substrate, comprising:

modifying a magnetic property of a portion of a magnetically susceptible layer of the magnetic substrate by exposing the portion to atom groups, wherein the atom groups have energy selected to modify the magnetic property without substantially modifying the shape of the substrate surface.

2. The method of claim 1, wherein the portions of the magnetically susceptible layer to be modified are identified by forming a patterned layer over the magnetically susceptible layer.

3. The method of claim 1, wherein the energy of the atom groups is selected to implant into the surface of the magnetically susceptible layer.

4. The method of claim 1, wherein the atom groups comprise boron, carbon, silicon, or germanium.

5. The method of claim 2, wherein the atom groups are ions having average energy less than about 50 keV.

6. The method of claim 2, wherein the atom groups are ions, and the atoms in the atom groups have average energy less than about 5 keV.

7. The method of claim 1, wherein the atom groups are selected from the group consisting of boron hydride ions having at least 10 boron atoms, silicon hydride ions having at least 10 silicon atoms, germanium hydride ions having at least 10 germanium atoms, hydrocarbon ions having at least 10 carbon atoms, cluster ions, nanocondensate ions, neutralized species thereof, combinations thereof, or mixtures thereof.

8. A method of treating a substrate, comprising:

forming a magnetically susceptible layer on a structural substrate;

forming a patterned layer over the magnetically susceptible layer to identify treatment zones and masked zones;

directing atom groups toward the substrate with energy sufficient to penetrate the patterned layer and implant into the treatment zones of the magnetically susceptible layer;

forming a protective layer over the substrate; and

forming a lubricating layer over the substrate.

9. The method of claim 8, wherein the atom groups are molecular ions, cluster ions, or neutralized species thereof, and the protective and lubricating layers have a total thickness less than about ten times an average maximum width of the treatment zones.

10. The method of claim 8, wherein implanting atom groups in the treatment zones reduces magnetic susceptibility of the treatment zones by at least 50%.

11. The method of claim 10, wherein implanting atom groups into the treatment zones increases Ra roughness of the substrate surface by less than 1 nm.

12. An apparatus for manufacturing magnetic storage media, comprising:

a source of large atom groups;

coupled to the source of large atom groups, an ion beam generator for generating large ions from the large atom groups; and

a substrate support comprising a plurality of substrate sites, wherein the substrate support can move with respect to the ion beam generator, or the ion beam generator can move with respect to the substrate support..

13. The apparatus of claim 12, further comprising a neutralizer disposed between the ion beam generator and the moveable substrate support.

14. A substrate having a magnetically susceptible layer comprising identifiable magnetic domains having dimension not larger than about 50 nm, and cobalt regions implanted with one or more elements from the group consisting of boron, nitrogen, oxygen, carbon, hydrogen, fluorine, silicon, germanium, neon, argon, and xenon.

15. The substrate of claim 14, wherein a surface of the substrate has R_a surface roughness less than about 5 nm.

Claims

1. A method of forming a magnetic substrate, comprising:

forming a carbon-containing patterned layer over a magnetically susceptible layer of a magnetic substrate; and

modifying a magnetic property of a portion of a magnetically susceptible layer of the magnetic substrate by exposing the portion to atom groups, wherein the atom groups have energy selected to modify the magnetic property without substantially modifying the shape of the substrate surface.

2. The method of claim 1, wherein the portions of the magnetically susceptible layer to be modified are identified by forming a patterned layer over the magnetically susceptible layer.

3. The method of claim 1, wherein the energy of the atom groups is selected to implant into the surface of the magnetically susceptible layer.

4. The method of claim 1, wherein the atom groups comprise boron, carbon, silicon, or germanium.

5. The method of claim 2, wherein the atom groups are ions having average energy less than about 50 keV.

6. The method of claim 2, wherein the atom groups are ions, and the atoms in the atom groups have average energy less than about 5 keV.

7. The method of claim 1, wherein the atom groups are selected from the group consisting of boron hydride ions having at least 10 boron atoms, silicon hydride ions having at least 10 silicon atoms, germanium hydride ions having at least 10 germanium atoms, hydrocarbon ions having at least 10 carbon atoms, cluster ions, nanocondensate ions, neutralized species thereof, combinations thereof, or mixtures thereof.

8. A method of treating a substrate, comprising:

forming a magnetically susceptible layer on a structural substrate;

forming a carbon-containing patterned layer over the magnetically susceptible layer to identify treatment zones and masked zones;

directing atom groups comprising carbon, silicon, or germanium toward the substrate with energy sufficient to penetrate the patterned layer and implant into the treatment zones of the magnetically susceptible layer;

forming a protective layer over the substrate; and

forming a lubricating layer over the substrate, wherein the protective and lubricating layers have a total thickness less than about ten times an average maximum width of the treatment zones.

9. The method of claim 8, wherein the atom groups are molecular ions, cluster ions, or neutralized species thereof.

10. The method of claim 8, wherein implanting atom groups in the treatment zones reduces magnetic susceptibility of the treatment zones by at least 50%.

11. The method of claim 10, wherein implanting atom groups into the treatment zones increases Ra roughness of the substrate surface by less than 1 nm.

12. An apparatus for manufacturing magnetic storage media, comprising:

a source of large atom groups comprising carbon, silicon, or germanium;

coupled to the source of large atom groups, an ion beam generator for generating large ions from the large atom groups; and

a substrate support comprising a plurality of substrate sites, wherein the substrate support can move with respect to the ion beam generator, or the ion beam generator can move with respect to the substrate support..

13. The apparatus of claim 12, further comprising a neutralizer disposed between the ion beam generator and the moveable substrate support.

14. A substrate having a magnetically susceptible layer comprising identifiable magnetic domains having dimension not larger than about 50 nm, and cobalt regions implanted with one or more elements from the group consisting of carbon, silicon, and germanium.

15. The substrate of claim 14, wherein a surface of the substrate has R_a surface roughness less than about 5 nm.