CLAIMS

1. A method of manufacturing an extreme ultraviolet (EUV) mask blank comprising:

forming a multilayer stack of reflective layers on a substrate, the multilayer stack of reflective layers including a plurality of reflective layer pairs;

forming a capping layer on the multilayer stack of reflective layers; and

forming a multilayer stack of absorber layers on the capping layer, the multilayer stack of absorber layers including a plurality of absorber layer pairs, each pair comprising two different absorber materials having extinction coefficient (k) values that are different and index of refraction values (n) that are different, wherein the absorber layer pairs comprise a first layer including an absorber material selected from the group consisting of tantalum (Ta), tantalum nitride (TaN), tantalum nitride oxide (TaNO), and tantalum borate (TaBO), and a second layer including an absorber material selected from the group consisting of platinum (Pt), zinc (Zn), gold (Au), nickel (Ni), nickel oxide (NiO), silver oxide (Ag_2O), iridium (Ir), iron (Fe), tin dioxide (SnO_2), cobalt (Co), chromium nickel alloys, Ni_8Cr_2, tin oxide (SnO), copper (Cu), silver (Ag), actinium (Ac), tellurium (Te), caesium iodide (CsI), tin (Sn), zinc telluride (ZnTe) and antimony (Sb).

2. The method of claim 1, wherein absorber layer pairs comprise a first layer including an absorber material selected from tantalum nitride (TaN)and a second layer selected from nickel (Ni).

3. The method of claim 1, wherein the absorber layer pairs comprise a first absorber layer and a second absorber layer, each of the first absorber layer and the second absorber layer each having a thickness in a range of 1 nm and 5 nm.

4. The method of claim 1, wherein the absorber layer pairs comprise a first absorber layer and a second absorber layer, each of the first absorber layer and the second absorber layer each having a thickness in a range of 1 nm and 3 nm.

5. The method of claim 1, wherein the different absorber materials and thickness of the absorber layers are selected so that extreme ultraviolet light is absorbed due to

absorbance and due to a phase change caused by destructive interfere with light from the multilayer stack of reflective layers.

6. The method of claim 1, wherein the plurality of absorber layer pairs are formed in a physical vapor deposition chamber having a first cathode comprising a first absorber material and a second cathode comprising a second absorber material.

7. The method of claim 1, wherein the method comprises forming a range of from 5 to 60 absorber layer pairs.

8. The method of claim 1, wherein the absorber layer pairs comprise a first layer including an absorber material selected from tantalum (Ta) and a second layer selected from an absorber material selected from the group consisting of platinum (Pt), zinc (Zn), gold (Au), nickel oxide (NiO), silver oxide (Ag_2O), iridium (Ir), iron (Fe), tin dioxide (SnO_2), cobalt (Co), chromium nickel alloys, Ni_8Cr_2, tin oxide (SnO), copper (Cu), silver (Ag), actinium (Ac), tellurium (Te), caesium iodide (CsI), tin (Sn), zinc telluride (ZnTe) and antimony (Sb).

9. The method of claim 1, wherein the absorber layer pairs comprise a first layer including an absorber material selected from tantalum nitride oxide (TaNO) and a second layer selected from an absorber material selected from the group consisting of platinum (Pt), zinc (Zn), gold (Au), nickel oxide (NiO), silver oxide (Ag_2O), iridium (Ir), iron (Fe), tin dioxide (SnO_2), cobalt (Co), chromium nickel alloys, Ni_8Cr_2, tin oxide (SnO), copper (Cu), silver (Ag), actinium (Ac), tellurium (Te), caesium iodide (CsI), tin (Sn), zinc telluride (ZnTe) and antimony (Sb).

10. The method of claim 1, wherein the absorber layer pairs comprise a first layer including an absorber material selected from tantalum borate (TaBO) and a second layer selected from an absorber material selected from the group consisting of platinum (Pt), zinc (Zn), gold (Au), nickel oxide (NiO), silver oxide (Ag_2O), iridium (Ir), iron (Fe), tin dioxide (SnO_2), cobalt (Co), chromium nickel alloys, Ni_8Cr_2, tin oxide (SnO), copper (Cu), silver (Ag), actinium (Ac), tellurium (Te), caesium iodide (CsI), tin (Sn), zinc telluride (ZnTe) and antimony (Sb).

11. An extreme ultraviolet (EUV) mask blank comprising:

a substrate;

a multilayer stack of reflective layers on the substrate, the multilayer stack of reflective layers including a plurality of reflective layers including reflective layer pairs;

a capping layer on the multilayer stack of reflecting layers; and

a multilayer stack of absorber layers on the capping layer, the multilayer stack of absorber layers including a plurality of absorber layer pairs, each pair comprising two different absorber materials having extinction coefficient (k) values that are different and index of refraction values (n) that are different wherein the absorber layer pairs comprise a first layer including an absorber material selected from the group consisting of tantalum (Ta), tantalum nitride (TaN), tantalum nitride oxide (TaNO), tantalum borate (TaBO) and a second layer including an absorber material selected from the group consisting of platinum (Pt), zinc (Zn), gold (Au), nickel (Ni) nickel oxide (NiO), silver oxide (Ag_2O), iridium (Ir), iron (Fe), tin dioxide (SnO_2), cobalt (Co), chromium nickel alloys, Ni_8Cr_2, tin oxide (SnO), copper (Cu), silver (Ag), actinium (Ac), tellurium (Te), caesium iodide (CsI), tin (Sn), zinc telluride (ZnTe) and antimony (Sb).

12. The extreme ultraviolet (EUV) mask blank of claim 11, wherein absorber layer pairs comprise a first layer including an absorber material selected from tantalum nitride (TaN) and a second layer selected including an absorber material selected from nickel (Ni) .

13. The extreme ultraviolet (EUV) mask blank of claim 11, wherein the absorber layer pairs comprise a first absorber layer and a second absorber layer, each of the first absorber layer and the second absorber layer each having a thickness in a range of 1 nm and 5 nm.

14. The extreme ultraviolet (EUV) mask blank of claim 11, wherein the absorber layer pairs comprise a first absorber layer and a second absorber layer, each of the first absorber layer and the second absorber layer each having a thickness in a range of 1 nm and 3 nm.

15. The extreme ultraviolet (EUV) mask blank of claim 14, there is a range of from 10 to 40 absorber layer pairs.

16. The extreme ultraviolet (EUV) mask blank of claim 11, wherein the different absorber materials and thickness of the absorber layers are selected so that extreme ultraviolet light is absorbed due to absorbance and due to a phase change caused by destructive interfere with light from the multilayer stack of reflective layers.

17. The extreme ultraviolet (EUV) mask blank of claim 11, wherein there is a range of 5 to 60 absorber layer pairs.

18. The extreme ultraviolet (EUV) mask blank of claim 11, wherein the absorber layer pairs comprise a first layer including an absorber material selected from tantalum (Ta) and a second layer selected from an absorber material selected from the group consisting of platinum (Pt), zinc (Zn), gold (Au), nickel oxide (NiO), silver oxide (Ag_2O), iridium (Ir), iron (Fe), tin dioxide (SnO_2), cobalt (Co), chromium nickel alloys, Ni_8Cr_2, tin oxide (SnO), copper (Cu), silver (Ag), actinium (Ac), tellurium (Te), caesium iodide (CsI), tin (Sn), zinc telluride (ZnTe) and antimony (Sb).

19. The extreme ultraviolet (EUV) mask blank of claim 11, wherein the absorber layer pairs comprise a first layer including an absorber material selected from tantalum nitride oxide (TaNO) and a second layer selected from an absorber material selected from the group consisting of platinum (Pt), zinc (Zn), gold (Au), nickel oxide (NiO), silver oxide (Ag_2O), iridium (Ir), iron (Fe), tin dioxide (SnO_2), cobalt (Co), chromium nickel alloys, Ni_8Cr_2, tin oxide (SnO), copper (Cu), silver (Ag), actinium (Ac), tellurium (Te), caesium iodide (CsI), tin (Sn), zinc telluride (ZnTe) and antimony (Sb).

20. The extreme ultraviolet (EUV) mask blank of claim 11, wherein the absorber layer pairs comprise a first layer including an absorber material selected from tantalum borate (TaBO) and a second layer selected from an absorber material selected from the group consisting of platinum (Pt), zinc (Zn), gold (Au), nickel oxide (NiO), silver

oxide (Ag_2O), iridium (Ir), iron (Fe), tin dioxide (SnO_2), cobalt (Co), chromium nickel alloys, Ni_8Cr_2, tin oxide (SnO), copper (Cu), silver (Ag), actinium (Ac), tellurium (Te), caesium iodide (CsI), tin (Sn), zinc telluride (ZnTe) and antimony (Sb).