

What is claimed is:

1. A method of manufacturing an extreme ultraviolet (EUV) mask blank comprising:
 - 5 providing a substrate;
 - forming a multilayer stack of reflective layers on the 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
 - 10 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.
- 15 2. The method of claim 1, wherein the plurality of reflective layer pairs are made from a material selected from molybdenum (Mo) containing material and silicon (Si) containing material and the absorber layers are made from a material selected from the group consisting of platinum (Pt), zinc (Zn), gold (Au), nickel oxide (NiO), silver oxide (Ag₂O), iridium (Ir), iron (Fe), tin dioxide (SnO₂), cobalt
- 20 (Co), chromium nickel alloys, Ni₈Cr₂, tin oxide (SnO), copper (Cu), silver (Ag), actinium (Ac), tellurium (Te), caesium iodide (CsI), tin (Sn), zinc telluride (ZnTe), antimony (Sb), tantalum (Ta), tantalum nitride (TaN), tantalum nitride oxide (TaNO), chromium (Cr), chromium nitride (CrN), and tantalum borate (TaBO).
- 25 3. The method of claim 1, 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
- 30 group consisting of platinum (Pt), zinc (Zn), gold (Au), nickel oxide (NiO), silver oxide (Ag₂O), iridium (Ir), iron (Fe), tin dioxide (SnO₂), cobalt (Co), chromium nickel alloys, in particular Ni₈Cr₂, tin oxide (SnO), copper (Cu), silver (Ag),

actinium (Ac), tellurium (Te), caesium iodide (CsI), tin (Sn), zinc telluride (ZnTe), chromium (Cr), chromium nitride (CrN) and antimony (Sb).

4. The method of claim 1, wherein absorber layer pairs comprise a first layer
5 including an absorber material selected from nickel (Ni) and a second layer
selected from tantalum nitride (TaN).
5. The method of claim 2, wherein the absorber layer pairs comprise a first layer
and a second absorber layer, each of the first absorber layer and the second
10 absorber layer each having a thickness in a range of 1 nm and 5 nm.
6. 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
15 with light from the multilayer stack of reflective layers.
7. 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
20 material.
8. An extreme ultraviolet (EUV) mask blank comprising:
a substrate;
a multilayer stack of reflective layers on the substrate, the multilayer
25 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
30 comprising two different absorber materials having extinction coefficient (k)
values that are different and index of refraction values (n) that are different.

9. The extreme ultraviolet (EUV) mask blank of claim 8, wherein the plurality of reflective layers are selected from molybdenum (Mo) containing material and silicon (Si) containing material and the absorber layers are made from materials selected from the group consisting of platinum (Pt), zinc (Zn), gold (Au), nickel oxide (NiO), silver oxide (Ag₂O), iridium (Ir), iron (Fe), tin dioxide (SnO₂), cobalt (Co), chromium nickel alloys, Ni₈Cr₂, tin oxide (SnO), copper (Cu), silver (Ag), actinium (Ac), tellurium (Te), caesium iodide (CsI), tin (Sn), zinc telluride (ZnTe), antimony (Sb), tantalum (Ta), tantalum nitride (TaN), tantalum nitride oxide (TaNO), chromium (Cr), chromium nitride (CrN), and tantalum borate (TaBO).
10. The extreme ultraviolet (EUV) mask blank of claim 8, 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 oxide (NiO), silver oxide (Ag₂O), iridium (Ir), iron (Fe), tin dioxide (SnO₂), cobalt (Co), chromium nickel alloys, in particular Ni₈Cr₂, tin oxide (SnO), copper (Cu), silver (Ag), actinium (Ac), tellurium (Te), caesium iodide (CsI), tin (Sn), zinc telluride (ZnTe), chromium (Cr), chromium nitride (CrN) and antimony (Sb).
11. The extreme ultraviolet (EUV) mask blank of claim 8, wherein absorber layer pairs comprise a first layer including an absorber material selected from nickel (Ni) and a second layer selected including an absorber material selected from tantalum nitride (TaN).
12. The extreme ultraviolet (EUV) mask blank of claim 9, 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.

13. The extreme ultraviolet (EUV) mask blank of claim 9, wherein the absorber layer pairs comprise a first 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
14. The extreme ultraviolet (EUV) mask blank of claim 9, 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.
- 10
15. An extreme ultraviolet (EUV) mask blank production system comprising:
- 15 a substrate handling vacuum chamber for creating a vacuum;
- a substrate handling platform, in the vacuum, for transporting a substrate loaded in the substrate handling vacuum chamber; and
- multiple sub-chambers, accessed by the substrate handling platform, for forming an EUV mask blank including:
- 20 a multilayer stack of reflective layers on the substrate, the multilayer stack including a plurality of reflective layer pairs including reflective layer pairs;
- a capping layer on the multilayer stack reflective layers; and
- 25 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.