EXTREME ULTRAVIOLET MASK ABSORBER MATERIALS

TECHNICAL FIELD

[0001] The present disclosure relates generally to extreme ultraviolet lithography, and more particularly extreme ultraviolet mask blanks with an alloy absorber and methods of manufacture.

BACKGROUND

[0002] Extreme ultraviolet (EUV) lithography, also known as soft x-ray projection lithography, can be used for the manufacture of 0.0135 micron and smaller minimum feature size semiconductor devices. However, extreme ultraviolet light, which is generally in the 5 to 100 nanometer wavelength range, is strongly absorbed in virtually all materials. For that reason, extreme ultraviolet systems work by reflection rather than by transmission of light. Through the use of a series of mirrors, or lens elements, and a reflective element, or mask blank, coated with a non-reflective absorber mask pattern, the patterned actinic light is reflected onto a resist-coated semiconductor substrate.

[0003] The lens elements and mask blanks of extreme ultraviolet lithography systems are coated with reflective multilayer coatings of materials such as molybdenum and silicon. Reflection values of approximately 65% per lens element, or mask blank, have been obtained by using substrates that are coated with multilayer coatings that strongly reflect light within an extremely narrow ultraviolet bandpass, for example, 12.5 to 14.5 nanometer bandpass for 13.5 nanometer ultraviolet light.

[0004] FIG. 1 shows a conventional EUV reflective mask 10, which is formed from an EUV mask blank, which includes a reflective multilayer stack 12 on a substrate 14, which reflects EUV radiation at unmasked portions by Bragg interference. Masked (non-reflective) areas 16 of the conventional EUV reflective mask 10 are formed by etching buffer layer 18 and absorbing layer 20. The absorbing layer typically has a thickness in a range of 51 nm to 77 nm. A capping layer 22 is formed over the reflective multilayer stack 12 and protects the reflective multilayer stack 12 during the etching process. As will be discussed further below, EUV mask blanks are made on a low thermal expansion material substrate coated with multilayers, a capping layer

chamber 232 can be in a separate system from the extreme ultraviolet reflective element production system 200.

[0040] The chemical vapor deposition system 228 can form thin films of material on the source substrates 203. For example, the chemical vapor deposition system 228 can be used to form layers of materials on the source substrates 203 including mono-crystalline layers, polycrystalline layers, amorphous layers, epitaxial layers, or a combination thereof. The chemical vapor deposition system 228 can form layers of silicon, silicon oxides, silicon oxycarbide, tantalum, tungsten, silicon carbide, silicon nitride, titanium nitride, metals, alloys, and other materials suitable for chemical vapor deposition. For example, the chemical vapor deposition system can form planarization layers.

[0041] The first wafer handling system 214 is capable of moving the source substrates 203 between the atmospheric handling system 206 and the various systems around the periphery of the first vacuum chamber 210 in a continuous vacuum. The second wafer handling system 216 is capable of moving the source substrates 203 around the second vacuum chamber 212 while maintaining the source substrates 203 in a continuous vacuum. The extreme ultraviolet reflective element production system 200 can transfer the source substrates 203 and the EUV mask blank 204 between the first wafer handling system 214 and the second wafer handling system 216 in a continuous vacuum.

[0042] Referring now to FIG. 4, an embodiment of an extreme ultraviolet reflective element 302 is shown. In one or more embodiments, the extreme ultraviolet reflective element 302 is the EUV mask blank 204 of FIG. 3 or the extreme ultraviolet mirror 205 of FIG. 3. The EUV mask blank 204 and the extreme ultraviolet mirror 205 are structures for reflecting the extreme ultraviolet light 112 of FIG. 2. The EUV mask blank 204 can be used to form the EUV reflective mask 106 shown in FIG. 2.

[0043] The extreme ultraviolet reflective element 302 includes a substrate 304, a multilayer stack 306 of reflective layers, and a capping layer 308. In one or more embodiments, the extreme ultraviolet mirror 205 is used to form reflecting structures for use in the condenser 104 of FIG. 2 or the optical reduction assembly 108 of FIG. 2.

[0044] The extreme ultraviolet reflective element 302, which can be a EUV mask blank 204, includes the substrate 304, the multilayer stack 306 of reflective layers, the

4.0 wt.%, 4.1 wt.%, 4.2 wt.%, 4.3 wt.%, 4.4 wt.%, 4.5 wt.%, 4.6 wt.%, 4.7 wt.%. 4.8 wt.%, 4.9 wt. %, or 5.0 wt.%.

[0072] In one or more embodiments, the alloy of the absorber layer is a co-sputtered alloy absorber material formed in a physical deposition chamber, which can provide much thinner absorber layer thickness (less than 30nm) while achieving less than 2% reflectivity and suitable etch properties. In one or more embodiments, the alloy of the absorber layer can be co-sputtered by gases selected from one or more of argon (Ar), oxygen (O_2), or nitrogen (N_2). In an embodiment, the alloy of the absorber layer can be co-sputtered by a mixture of argon and oxygen gases ($Ar + O_2$). In some embodiments, co-sputtering by a mixture of argon and oxygen forms an oxide of tantalum and/or an oxide of antimony. In other embodiments, co-sputtering by a mixture of argon and oxygen does not form an oxide of tantalum or antimony. In an embodiment, the alloy of the absorber layer can be co-sputtered by a mixture of argon and nitrogen gases ($Ar + N_2$). In some embodiments, co-sputtering by a mixture of argon and nitrogen forms a nitride of tantalum and/or a nitride of antimony. In other embodiments, co-sputtering by a mixture of argon and nitrogen does not form a nitride of tantalum or antimony. In an embodiment, the alloy of the absorber layer can be co-sputtered by a mixture of argon and oxygen and nitrogen gases ($Ar + O_2 + N_2$). In some embodiments, co-sputtering by a mixture of argon and oxygen and nitrogen forms an oxide and/or nitride of tantalum and/or an oxide and/or nitride of antimony. In other embodiments, co-sputtering by a mixture of argon and oxygen and nitrogen does not form an oxide or a nitride of tantalum or antimony. In an embodiment, the etch properties and/or other properties of the absorber layer can be tailored to specification by controlling the alloy percentage(s), as discussed above. In an embodiment, the alloy percentage(s) can be precisely controlled by operating parameters such voltage, pressure, flow, etc., of the physical vapor deposition chamber. In an embodiment, a process gas is used to further modify the material properties, for example, N_2 gas is used to form nitrides of tellurium, germanium and antimony.

[0073] In one or more embodiments, as used herein “co-sputtering” means that two targets, one target comprising tantalum and the second target comprising antimony are sputtered at the same time using one or more gas selected from argon (Ar),

a mixture of argon and oxygen forms an oxide of tantalum and/or an oxide of antimony. In other embodiments, bulk target deposition using a mixture of argon and oxygen does not form an oxide of tantalum or antimony. In an embodiment, the alloy of the absorber layer can be deposited using a bulk target having the same composition of the alloy and is sputtered using a mixture of argon and nitrogen gases ($Ar + N_2$). In some embodiments, bulk target deposition using a mixture of argon and nitrogen forms a nitride of tantalum and/or a nitride of antimony. In other embodiments, bulk target deposition using a mixture of argon and nitrogen does not form a nitride of tantalum or antimony. In an embodiment, the alloy of the absorber layer can be deposited using a bulk target having the same composition of the alloy and is sputtered using a mixture of argon and oxygen and nitrogen gases ($Ar + O_2 + N_2$). In some embodiments, bulk target depositing using a mixture of argon and oxygen and nitrogen forms an oxide and/or nitride of tantalum and/or an oxide and/or nitride of antimony. In other embodiments, bulk target deposition using a mixture of argon and oxygen and nitrogen does not form an oxide or a nitride of tantalum or antimony. In some embodiments, the alloy of tellurium, germanium and antimony is doped with carbon in a range of 3 wt.% to 15 wt.% (e.g., 5 wt.% to 10 wt.%, such as about 8 wt.%). In other embodiments, the alloy of tellurium, germanium and antimony is doped with one or more of nitrogen or oxygen in a range of from 0.1 wt.% to 5 wt.%. In some embodiments, the alloy of tellurium, germanium and antimony is doped with carbon in a range of 3 wt.% to 15 wt.% (e.g., 5 wt.% to 10 wt.%, such as about 8 wt.%) and doped with one of more of nitrogen or oxygen in a range of from 0.1 wt.% to 5 wt.%. In embodiments in which the alloy of tellurium, germanium and antimony is doped with carbon, the carbon doping can be achieved by co-sputtering with a carbon target, or by sputtering with a target comprising carbon, tellurium, germanium and antimony.

[0076] The EUV mask blank can be made in a physical deposition chamber having a first cathode comprising a first absorber material, a second cathode comprising a second absorber material, a third cathode comprising a third absorber material, a fourth cathode comprising a fourth absorber material, and a fifth cathode comprising a fifth absorber material, wherein the first absorber material, second absorber material, third absorber material, fourth absorber material and fifth absorber materials are

different from each other, and each of the absorber materials have an extinction coefficient that is different from the other materials, and each of the absorber materials have an index of refraction that is different from the other absorber materials.

[0077] Referring now to FIG. 5, an extreme ultraviolet mask blank 400 is shown as comprising a substrate 414, a multilayer stack of reflective layers 412 on the substrate 414, the multilayer stack of reflective layers 412 including a plurality of reflective layer pairs. In one or more embodiments, the plurality of reflective layer pairs are made from a material selected from a molybdenum (Mo) containing material and silicon (Si) containing material. In some embodiments, the plurality of reflective layer pairs comprise alternating layers of molybdenum and silicon. The extreme ultraviolet mask blank 400 further includes a capping layer 422 on the multilayer stack of reflective layers 412, and there is a multilayer stack 420 of absorber layers on the capping layer 422. In one or more embodiment, the plurality of reflective layers 412 is selected from a molybdenum (Mo) containing material and a silicon (Si) containing material and the capping layer 422 comprises ruthenium.

[0078] The multilayer stack 420 of absorber layers includes a plurality of absorber layer pairs 420a, 420b, 420c, 420d, 420e, 420f, each pair (420a/420b, 420c/420d, 420e/420f) comprising an alloy of tellurium, germanium and antimony. In some embodiments, the alloy of tellurium, germanium and antimony comprises about 33.9 wt.% to about 53.9 wt.% tellurium, about 6.8 wt.% to about 26.8 wt.% germanium, and about 21.3 wt.% to about 41.3 wt.% antimony based upon the total weight of the alloy. In one or more embodiments, the alloy of tellurium, germanium and antimony comprises about 38.9 wt.% to about 48.9 wt.% tellurium, about 11.8 wt.% to about 21.8 wt.% germanium, and about 26.3 wt.% to about 36.3 wt.% antimony based upon the total weight of the alloy. In one or more embodiments, the alloy of tellurium, germanium and antimony comprises about 43.9 wt.% tellurium, about 16.8 wt.% germanium, and about 31.3 wt.% antimony based upon the total weight of the alloy. In one or more embodiments, the alloy of tellurium, germanium and antimony is amorphous.

[0079] In one example, absorber layer 420a is made from antimony and the material that forms absorber layer 420b is tantalum. Likewise, absorber layer 420c is made from antimony and the material that forms absorber layer 420d is tantalum,

and absorber layer 420e is made from antimony material and the material that forms absorber layer 420f is tantalum.

[0080] In one embodiment, the extreme ultraviolet mask blank 400 includes the plurality of reflective layers 412 selected from molybdenum (Mo) containing material and silicon (Si) containing material, for example, molybdenum (Mo) and silicon (Si). The absorber materials that are used to form the absorber layers 420a, 420b, 420c, 420d, 420e and 420f are an alloy of tellurium, germanium and antimony. In some embodiments, the alloy of tellurium, germanium and antimony comprises about 33.9 wt.% to about 53.9 wt.% tellurium, about 6.8 wt.% to about 26.8 wt.% germanium, and about 21.3 wt.% to about 41.3 wt.% antimony based upon the total weight of the alloy. In one or more embodiments, the alloy of tellurium, germanium and antimony comprises about 38.9 wt.% to about 48.9 wt.% tellurium, about 11.8 wt.% to about 21.8 wt.% germanium, and about 26.3 wt.% to about 36.3 wt.% antimony based upon the total weight of the alloy. In one or more embodiments, the alloy of tellurium, germanium and antimony comprises about 43.9 wt.% tellurium, about 16.8 wt.% germanium, and about 31.3 wt.% antimony based upon the total weight of the alloy. In one or more embodiments, the alloy of tellurium, germanium and antimony is amorphous.

[0081] In one or more embodiments, the absorber layer pairs 420a/420b, 420c/420d, 420e/420f comprise a first layer (420a, 420c, 420e) including an absorber material comprising an alloy of tellurium, germanium and antimony and a second absorber layer (420b, 420d, 420f) including an absorber material including an alloy of tellurium, germanium and antimony. In specific embodiments, the absorber layer pairs comprise a first layer (420a, 420c, 420e) including an alloy of tellurium, germanium and antimony, the alloy of tellurium, germanium and antimony selected from an alloy having about the alloy of tellurium, germanium and antimony, and a second absorber layer (420b, 420d, 420f) including an absorber material including an alloy of tellurium, germanium and antimony.

[0082] According to one or more embodiments, the absorber layer pairs comprise a first layer (420a, 420c, 420e) and a second absorber layer (420b, 420d, 420f) each of the first absorber layers (420a, 420c, 420e) and second absorber layer (420b, 420d, 420f) have a thickness in a range of 0.1 nm and 10 nm, for example in a range

of 1 nm and 5 nm, or in a range of 1 nm and 3 nm. In one or more specific embodiments, the thickness of the first layer 420a is 0.5 nm, 0.6 nm, 0.7 nm, 0.8 nm, 0.9 nm, 1 nm, 1.1 nm, 1.2 nm, 1.3 nm, 1.4 nm, 1.5 nm, 1.6 nm, 1.7 nm, 1.8 nm, 1.9 nm, 2 nm, 2.1 nm, 2.2 nm, 2.3 nm, 2.4 nm, 2.5 nm, 2.6 nm, 2.7 nm, 2.8 nm, 2.9 nm, 3 nm, 3.1 nm, 3.2 nm, 3.3 nm, 3.4 nm, 3.5 nm, 3.6 nm, 3.7 nm, 3.8 nm, 3.9 nm, 4 nm, 4.1 nm, 4.2 nm, 4.3 nm, 4.4 nm, 4.5 nm, 4.6 nm, 4.7 nm, 4.8 nm, 4.9 nm, and 5 nm. In one or more embodiments, the thickness of the first absorber layer and second absorber layer of each pair is the same or different. For example, the first absorber layer and second absorber layer have a thickness such that there is a ratio of the first absorber layer thickness to second absorber layer thickness of 1:1, 1.5:1, 2:1, 2.5:1, 3:1, 3.5:1, 4:1, 4.5:1, 5:1, 6:1, 7:1, 8:1, 9:1, 10:1, 11:1, 12:1, 13:1, 14:1, 15:1, 16:1, 17:1, 18:1, 19:1, or 20:1, which results in the first absorber layer having a thickness that is equal to or greater than the second absorber layer thickness in each pair. Alternatively, the first absorber layer and second absorber layer have a thickness such that there is a ratio of the second absorber layer thickness to first absorber layer thickness of 1.5:1, 2:1, 2.5:1, 3:1, 3.5:1, 4:1, 4.5:1, 5:1, 6:1, 7:1, 8:1, 9:1, 10:1, 11:1, 12:1, 13:1, 14:1, 15:1, 16:1, 17:1, 18:1, 19:1, or 20:1 which results in the second absorber layer having a thickness that is equal to or greater than the first absorber layer thickness in each pair.

[0083] According to one or more embodiments, 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. While the embodiment shown in FIG. 5 shows three absorber layer pairs, 420a/420b, 420c/420d and 420e/420f, the claims should not be limited to a particular number of absorber layer pairs. According to one or more embodiments, the EUV mask blank 400 can include in a range of 5 and 60 absorber layer pairs or in a range of 10 and 40 absorber layer pairs.

[0084] According to one or more embodiments, the absorber layers have a thickness which provides less than 2% reflectivity and other etch properties. A supply gas can be used to further modify the material properties of the absorber layers, for example, nitrogen (N_2) gas can be used to form nitrides of the materials provided

above. The multilayer stack of absorber layers according to one or more embodiments is a repetitive pattern of individual thickness of different materials so that the EUV light not only gets absorbed due to absorbance but by the phase change caused by multilayer absorber stack, which will destructively interfere with light from multilayer stack of reflective materials beneath to provide better contrast.

[0085] Another aspect of the disclosure pertains to a method of manufacturing an extreme ultraviolet (EUV) mask blank comprising forming on a substrate a multilayer stack of reflective layers on the substrate, the multilayer stack including a plurality of reflective layer pairs, forming a capping layer on the multilayer stack of reflective layers, and forming absorber layer on the capping layer, the absorber layer comprising an alloy of tellurium, germanium and antimony, wherein the alloy of tellurium, germanium and antimony comprises about 33.9 wt.% to about 53.9 wt.% tellurium, about 6.8 wt.% to about 26.8 wt.% germanium, and about 21.3 wt.% to about 41.3 wt.% antimony based upon the total weight of the alloy. In one or more embodiments, the alloy of tellurium, germanium and antimony comprises about 38.9 wt.% to about 48.9 wt.% tellurium, about 11.8 wt.% to about 21.8 wt.% germanium, and about 26.3 wt.% to about 36.3 wt.% antimony based upon the total weight of the alloy. In one or more embodiments, the alloy of tellurium, germanium and antimony comprises about 43.9 wt.% tellurium, about 16.8 wt.% germanium, and about 31.3 wt.% antimony based upon the total weight of the alloy. In one or more embodiments, the alloy of tellurium, germanium and antimony is amorphous.

[0086] The EUV mask blank can have any of the characteristics of the embodiments described above with respect to FIG. 4 and FIG. 5, and the method can be performed in the system described with respect to FIG. 3.

[0087] Thus, in an embodiment, the plurality of reflective layers are selected from molybdenum (Mo) containing material and silicon (Si) containing material and the absorber layer is an alloy of tellurium, germanium and antimony, wherein the alloy of tellurium, germanium and antimony comprises about the alloy of tellurium, germanium and antimony comprises about 33.9 wt.% to about 53.9 wt.% tellurium, about 6.8 wt.% to about 26.8 wt.% germanium, and about 21.3 wt.% to about 41.3 wt.% antimony based upon the total weight of the alloy. In one or more embodiments, the alloy of

tellurium, germanium and antimony comprises about 38.9 wt.% to about 48.9 wt.% tellurium, about 11.8 wt.% to about 21.8 wt.% germanium, and about 26.3 wt.% to about 36.3 wt.% antimony based upon the total weight of the alloy. In one or more embodiments, the alloy of tellurium, germanium and antimony comprises about 43.9 wt.% tellurium, about 16.8 wt.% germanium, and about 31.3 wt.% antimony based upon the total weight of the alloy. In one or more embodiments, the alloy of tellurium, germanium and antimony is amorphous.

[0088] In another specific method embodiment, the different absorber layers are formed in a physical deposition chamber having a first cathode comprising a first absorber material and a second cathode comprising a second absorber material. Referring now to FIG. 6 an upper portion of a multi-cathode source chamber 500 is shown in accordance with an embodiment. The multi-cathode chamber 500 includes a base structure 501 with a cylindrical body portion 502 capped by a top adapter 504. The top adapter 504 has provisions for a number of cathode sources, such as cathode sources 506, 508, 510, 512, and 514, positioned around the top adapter 504.

[0089] In one or more embodiments, the method forms an absorber layer that has a thickness in a range of 5 nm and 60 nm. In one or more embodiments, the absorber layer has a thickness in a range of 51 nm and 57 nm. In one or more embodiments, the materials used to form the absorber layer are selected to effect etch properties of the absorber layer. In one or more embodiments, The alloy of the absorber layer is formed by co-sputtering an alloy absorber material formed in a physical deposition chamber, which can provide much thinner absorber layer thickness (less than 30nm) and achieving less than 2% reflectivity and desired etch properties. In an embodiment, the etch properties and other desired properties of the absorber layer can be tailored to specification by controlling the alloy percentage of each absorber material. In an embodiment, the alloy percentage can be precisely controlled by operating parameters such voltage, pressure, flow etc., of the physical vapor deposition chamber. In an embodiment, a process gas is used to further modify the material properties, for example, N_2 gas is used to form nitrides of tellurium, germanium and antimony. The alloy absorber material can comprise an alloy of tellurium, germanium and antimony selected from an alloy comprising about the alloy of tellurium, germanium and antimony comprises about 33.9 wt.% to about 53.9 wt.% tellurium,

What is claimed is:

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

forming on a substrate a multilayer stack which reflects EUV radiation, the multilayer stack comprising a plurality of reflective layer pairs;

forming a capping layer on the multilayer stack; and

forming an absorber layer on the capping layer, the absorber layer comprising an alloy of tellurium, germanium and antimony.

2. The method of claim 1, wherein the alloy of tellurium, germanium and antimony comprises about 33.9 wt.% to about 53.9 wt.% tellurium, about 6.8 wt.% to about 26.8 wt.% germanium, and about 21.3 wt.% to about 41.3 wt.% antimony.

3. The method of claim 1, wherein the alloy of tellurium, germanium and antimony comprises about 38.9 wt.% to about 48.9 wt.% tellurium, about 11.8 wt.% to about 21.8 wt.% germanium, and about 26.3 wt.% to about 36.3 wt.% antimony.

4. The method of claim 2, wherein the alloy of tellurium, germanium and antimony comprises about 43.9 wt.% tellurium, about 16.8 wt.% germanium, and about 31.3 wt.% antimony.

5. The method of claim 3, wherein the alloy of tellurium, germanium and antimony is amorphous.

6. The method of claim 1, wherein the alloy is formed by co-sputtering the tellurium, germanium and antimony with a gas selected from one or more of argon (Ar), oxygen (O_2), or nitrogen (N_2) to form the absorber layer.

7. The method of claim 1, wherein the alloy is deposited layer by layer as a laminate of tellurium, germanium and antimony layers using a gas selected from one or more of argon (Ar), oxygen (O_2), or nitrogen (N_2) to form the absorber layer.

8. The method of claim 1, wherein the alloy is deposited using a bulk target having the same composition as the alloy and is sputtered using a gas selected from one or more of argon (Ar), oxygen (O_2), or nitrogen (N_2) to form the absorber layer.

9. The method of claim 2, wherein the alloy of tellurium, germanium and antimony is doped with carbon in a range of 3 wt.% to 15 wt.% and doped with one of more of nitrogen or oxygen in a range of from 0.1 wt.% to 5 wt.%.

10. The method of claim 3, wherein the alloy of tellurium, germanium and antimony is doped with carbon in a range of 5 wt.% to 10 wt.% and doped with one of more of nitrogen or oxygen in a range of from about 0.1 wt.% to about 5 wt.%.

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

a substrate;

a multilayer stack which reflects EUV radiation, the multilayer stack comprising a plurality of reflective layer pairs;

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

an absorber layer comprising an alloy of tellurium, germanium and antimony.

12. The extreme ultraviolet (EUV) mask blank of claim 11, wherein the alloy of tellurium, germanium and antimony comprises about 33.9 wt.% to about 53.9 wt.% tellurium, about 6.8 wt.% to about 26.8 wt.% germanium, and about 21.3 wt.% to about 41.3 wt.% antimony.

13. The extreme ultraviolet (EUV) mask blank of claim 11, the alloy of tellurium, germanium and antimony comprises about 38.9 wt.% to about 48.9 wt.% tellurium, about 11.8 wt.% to about 21.8 wt.% germanium, and about 26.3 wt.% to about 36.3 wt.% antimony.

14. The extreme ultraviolet (EUV) mask blank of claim 12, wherein the alloy of tellurium, germanium and antimony comprises about 43.9 wt.% tellurium, about 16.8 wt.% germanium, and about 31.3 wt.% antimony.

15. The extreme ultraviolet (EUV) mask blank of claim 13, wherein the alloy of tellurium, germanium and antimony is amorphous.

16. The extreme ultraviolet (EUV) mask blank of claim 11, wherein the absorber layer has a thickness of less than 45 nm.

17. The extreme ultraviolet (EUV) mask blank of claim 11, wherein the absorber layer further comprises a range of rom about 0.1 wt.% to about 5 wt.% of a dopant selected from one or more of nitrogen or oxygen.

18. The extreme ultraviolet (EUV) mask blank of claim 11, wherein the absorber layer has a thickness of less than 45 nm.

19. The extreme ultraviolet (EUV) mask blank of claim 11, wherein the absorber layer is etch selective relative to the capping layer.

20. An extreme ultraviolet (EUV) mask blank comprising:
a substrate;
a multilayer stack which reflects EUV radiation, the multilayer stack comprising a plurality of reflective layer pairs including molybdenum (Mo) and silicon (Si);
a capping layer on the multilayer stack of reflecting layers; and
an absorber layer comprising an alloy of tellurium, germanium and antimony.