In one aspect, the invention provides a reflective mask blank that is a material for a reflective mask used in EUV lithography using EUV light as exposure light, including a substrate, a multilayer reflection film that is formed on one main surface of the substrate and reflects the exposure light, and an absorber film that is formed on the multilayer reflection film and absorbs the exposure light, wherein

the absorber film contains

(a) tungsten; and

(b) at least one element selected from the group consisting of metalloids and metals excluding tungsten, (c) at least one light element selected from the group consisting of nitrogen, oxygen, carbon and hydrogen, or both (b) and (c).

In another aspect, the present disclosure provides a reflective mask blank that is a material for a reflective mask used in EUV lithography using EUV light as exposure light, comprising a substrate, a multilayer reflection film that is formed on one main surface of the substrate and reflects the exposure light, and an absorber film that is formed on the multilayer reflection film and absorbs the exposure light, wherein the absorber film consists of (a) tungsten; and (b) at least one element selected from tantalum, molybdenum, vanadium, zirconium, ruthenium, gold, platinum, rhodium, silicon and germanium, or (c) at least one light element selected from nitrogen, oxygen, carbon and hydrogen, or both (b) and (c).

Preferably, the absorber film consists of (a) tungsten, and (b) at least one element selected from the group consisting of metalloids and metals excluding tungsten.

Preferably, the absorber film contains (a) tungsten, (b) at least one element selected from the group consisting of metalloids and metals excluding tungsten, and (c) at least one light element selected from the group consisting of nitrogen, oxygen, carbon and hydrogen.

Preferably, a total content of (a) tungsten, (b) at least one element selected from the group consisting of metalloids and metals excluding tungsten, and (c) at least one light element selected from the group consisting of nitrogen, oxygen, carbon and hydrogen is not less than 90 at%.

Preferably, (b) at least one element selected from the group consisting of metalloids and metals excluding tungsten is either or both of molybdenum and ruthenium.

Preferably, a content of (b) at least one element selected from the group consisting of metalloids and metals excluding tungsten is not less than 1 at% and not more than 80 at%.

Preferably, the absorber film contains (a) tungsten, and (c) at least one light element selected from the group consisting of nitrogen, oxygen, carbon and hydrogen, and is free of metalloids and metals excluding tungsten.

Preferably, a content of (c) at least one light element selected from the group consisting of nitrogen, oxygen, carbon and hydrogen is not less than 10 at% and not more than 80 at%.

Preferably, a total content of (a) tungsten, and (c) at least one light element selected from the group consisting of nitrogen, oxygen, carbon and hydrogen is not less than 90 at%.

CLAIMS:

1. A reflective mask blank that is a material for a reflective mask used in EUV lithography using EUV light as exposure light, comprising a substrate, a multilayer reflection film that is formed on one main surface of the substrate and reflects the exposure light, and an absorber film that is formed on the multilayer reflection film and absorbs the exposure light, wherein the absorber film consists of

(a) tungsten; and

(b) at least one element selected from tantalum, molybdenum, vanadium, zirconium, ruthenium, gold, platinum, rhodium, silicon and germanium, or (c) at least one light element selected from nitrogen, oxygen, carbon and hydrogen, or both (b) and (c).

2. The reflective mask blank of claim 1 wherein the absorber film consists of (a) tungsten, and (b) at least one element selected from tantalum, molybdenum, vanadium, zirconium, ruthenium, gold, platinum, rhodium, silicon and germanium.

3. The reflective mask blank of claim 1 wherein the absorber film consists of (a) tungsten, (b) at least one element selected from tantalum, molybdenum, vanadium, zirconium, ruthenium, gold, platinum, rhodium, silicon and germanium, and (c) at least one light element selected from nitrogen, oxygen, carbon and hydrogen.

4. The reflective mask blank of any one of claims 1 to 3 wherein the element (b) comprises either or both of molybdenum and ruthenium.

5. The reflective mask blank of claim 4 comprising a protection film composed of a material containing ruthenium (Ru) wherein the protection film is intervened between the multilayer reflection film and the absorber film, is contact with the multilayer reflection film, and has different etching property from the absorber film.

6. The reflective mask blank of any one of claims 1 to 5 wherein a content of (b) in the absorber film is not less than 1 at% and not more than 80 at%.

7. The reflective mask blank of claim 1 wherein the absorber film consists of (a) tungsten, and (c) at least one light element selected from nitrogen, oxygen, carbon and hydrogen.

8. The reflective mask blank of claim 7 comprising a protection film wherein the protection film is intervened between the multilayer reflection film and the absorber film, is contact with the multilayer reflection film, and has different etching property from the absorber film.

9. The reflective mask blank of claim 1, 3 or 7 wherein a content of (c) at least one light element selected from nitrogen, oxygen, carbon and hydrogen is not less than 10 at% and not more than 80 at%.

10. The reflective mask blank of any one of claims 1 to 9 wherein a content of (a) tungsten in the absorber film is not less than 20 at% and not more than 99 at%.

11. The reflective mask blank of any one of claims 1 to 10 wherein the absorber film has a refractive index n of not more than 0.94 with respect to the exposure light.

12. The reflective mask blank of any one of claims 1 to 11 wherein the absorber film has a thickness of not more than 70 nm.

13. The reflective mask blank of any one of claims 1 to 12 further comprising a conductive film formed on the other main surface of the substrate.

14. The reflective mask blank of any one of claims 1 to 12 further comprising a film containing chromium formed as an etching mask on the absorber film.

15. A reflective mask manufactured from the reflective mask blank of any one of claims 1 to 14.