CLAIMS

1. A reflective mask comprising:

a substrate;

a reflective film configured to reflect an EUV light having a multi-layer film structure formed on the substrate;

a protective film formed on the reflective film, and configured to protect the reflective film;

an absorption film configured to absorb the EUV light formed on the protective film; and

an oxide coating formed on the absorption film;

wherein

the absorption film contains Sn and a metal element other than Sn and has a ratio of an atomic weight of the Sn to a total atomic weight of the metal element other than Sn (Sn/Metal element other than Sn) within a range of 1 or more and less than 20, and

the oxide coating is resistant to a hydrogen radical and formed on a surface and side surfaces of the absorption film.

2. A reflective mask comprising:

a substrate;

a reflective film configured to reflect an EUV light having a multi-layer film structure formed on the substrate;

a protective film formed on the reflective film, and configured to protect the reflective film;

an absorption film configured to absorb the EUV light formed on the protective film; and

an oxide coating formed on the absorption film;

wherein

the absorption film contains Sn in a proportion of 50 at% or more, and

the oxide coating is resistant to a hydrogen radical and formed on a surface and side surfaces of the absorption film.

3. The reflective mask according to claim 1 or 2, wherein the oxide coating contains a compound containing at least one of oxides of Cr, Ta, Nb, Ti, Al, V, and Hf.

4. The reflective mask according to any one of claims 1 to 3, wherein the oxide coating does not contain Sn or the oxide coating contains Sn, and a content of the Sn is smaller than a content of the compound containing at least one of oxides of Cr, Ta, Nb, Ti, Al, V, and Hf.

5. The reflective mask according to any one of claims 1 to 4, wherein the absorption film contains a compound containing at least one of Cr, Ta, Nb, Ti, Al, V, and Hf as the metal element other than Sn.

6. The reflective mask according to any one of claims 1 to 5, wherein the oxide coating has a film thickness of 1 nm or more.

7. The reflective mask according to any one of claims 1 to 6, wherein the absorption film does not contain B, C, P, Si, and Ge, which are metalloid elements, or contains at least one of the metalloid elements, and has a

ratio of a total atomic weight of the metalloid element to a total atomic weight of the metal element other than Sn (Metalloid element/Metal element other than Sn) within a range of 0 or more and 1 or less.

8. The reflective mask according to any one of claims 1 to 7, wherein the absorption film contains the compound containing at least one of Cr, Ta, Nb, Ti, Al, V, and Hf in a proportion of more than 5 at%.

9. The reflective mask according to any one of claims 1 to 8, wherein the absorption film is able to be etched with a fluorine-based gas or a chlorine-based gas.

10. The reflective mask according to any one of claims 1 to 9, wherein a total film thickness of the absorption film and the oxide coating is 45 nm or less, and an OD value (Optical Density) of the total film thickness of the absorption film and the oxide coating with respect to EUV light is 1.0 or more.

11. The reflective mask according claims 10, wherein the EUV light has wavelength of 13.5nm.

12. A method for producing a reflective mask, the reflective mask including:

a substrate;

a reflective film configured to reflect an EUV light having a multi-layer film structure formed on the substrate;

a protective film configured to protect the reflective film formed on the reflective film;

an absorption film configured to absorb the EUV light formed on the protective film; and

an oxide coating formed on the absorption film;

wherein

the absorption film contains Sn and a metal element other than Sn and has a ratio of an atomic weight of the Sn to a total atomic weight of the metal element other than Sn (Sn/Metal element other than Sn) within a range of 1 or more and less than 20, and

the oxide coating is resistant to a hydrogen radical and formed on a surface and side surfaces of the absorption film.

13. A method for producing a reflective mask, the reflective mask including:

a substrate;

a reflective film configured to reflect an EUV light having a multi-layer film structure formed on the substrate;

a protective film configured to protect the reflective film formed on the reflective film;

an absorption film configured to absorb the EUV light formed on the protective film; and

an oxide coating formed on the absorption film;

wherein

the absorption film contains Sn in a proportion of 50 at% or more, and

the oxide coating is resistant to a hydrogen radical and formed on a surface and side surfaces of the absorption film.

14. The method for producing a reflective mask according to claim 12 or 13, wherein the oxide coating is formed by oxidizing the absorption film.