CLAIMS

1. A reflective mask blank comprising:

a substrate (10);

a multilayer reflective film (20) that is provided on the substrate (10) and reflects exposure light;

a protective film (50) including a metal oxide film (51) provided on the multilayer reflective film; and

an absorber film (70) that is provided on the protective film (50) and absorbs exposure light, wherein

the multilayer reflective film (20) is configured such that a Mo layer and a Si layer are alternately stacked,

a layer on a side farthest from the substrate (10) is the Si layer, and

the metal oxide film (51) is configured such that an oxygen content in a layer on a side far from the substrate (10) is higher than the oxygen content in a layer on a substrate (10) side and

the oxygen content in the metal oxide film continuously increases as the distance from the substrate (10) increases.

2. The reflective mask blank according to claim 1, wherein

a metal contained in the metal oxide film (51) is a metal whose extinction coefficient k for EUV light having a wavelength of 13.53 nm is less than 0.02.

3. The reflective mask blank according to claim 1 or 2, wherein

the protective film (50) functions as an etching stopper

while the absorber film (70) is being processed.

4. The reflective mask blank according to any one of claims 1 to 3, wherein

the metal oxide film (51) contains at least one of Zr, Nb, Ti, and Y.

5. The reflective mask blank according to any one of claims 1 to 4, wherein

the oxygen content in the layer of the metal oxide film (51) on the side far from the substrate (10) does not change by heat treatment at 120°C to 200°C.

6. The reflective mask blank according to any one of claims 1 to 5, wherein

a thickness of the metal oxide film (51) is 0.5 nm or more and less than 3.5 nm.

7. The reflective mask blank according to any one of claims 1 to 6, wherein

the metal oxide film (51) has a multilayer structure and is configured such that an oxygen content in a second layer located on the side far from the substrate (10) is higher than an oxygen content in a first layer located on the substrate (10) side.

8. The reflective mask blank according to any one of claims 1 to 7, wherein the Si layer of the multilayer reflective film (20) on a side farthest from the substrate (10) contains a

light element other than oxygen on a metal oxide film (51) side.

9. The reflective mask blank according to any one of claims 1 to 8, further comprising

an oxidation inhibition layer between the Si layer of the multilayer reflective film (20) on a side farthest from the substrate (10) and the metal oxide film, the oxidation inhibition layer containing a light element other than oxygen on a metal oxide film (51) side, wherein

a thickness of the oxidation inhibition layer is 0.2 nm or more and 3 nm or less.

10. The reflective mask blank according to claim 8 or 9, wherein

the light element is one or more of nitrogen, carbon, and boron.

11. The reflective mask blank according to any one of claims 1 to 10, wherein in a case where first reflectance with respect to EUV light having a wavelength of 13.53 nm before heat treatment at 120°C to 200°C and second reflectance with respect to the EUV light having a wavelength of 13.53 nm after the heat treatment at 120°C to 200°C are compared, a change of the second reflectance with respect to the first reflectance is 0.5% or less.

12. A method for manufacturing a reflective mask comprising manufacturing a reflective mask by using the reflective mask

blank according to any one of claims 1 to 11.