CLAIMS

1. A reflective mask blank comprising:

a substrate;

a multilayer reflective film provided on the substrate; and

an absorber film provided on the multilayer reflective film,

wherein the absorber film includes at least one high absorption coefficient element selected from a group consisting of cobalt (Co) and nickel (Ni) and an element that increases a dry etching rate in at least a part of the absorber film,

the absorber film includes a lower surface region including a surface on a side of the substrate and an upper surface region including a surface on a side opposite to the substrate, ~~and~~

a concentration (atomic %) of the high absorption coefficient element in the upper surface region is higher than a concentration (atomic %) of the high absorption coefficient element in the lower surface region, and

a material of the upper surface region consists of a material comprising the high absorption coefficient element or a material comprising the high absorption coefficient element and the element that increases a dry etching rate.

2. The reflective mask blank according to claim 1, wherein a concentration (atomic %) of the element that increases the dry etching rate in the lower surface region is higher than a concentration (atomic %) of the element that increases the dry etching rate in the upper surface region.

3. The reflective mask blank according to claim 1 or 2, wherein the element that increases the dry etching rate is at least one element selected from a group consisting of tantalum (Ta), tungsten (W), and tin (Sn).

4. The reflective mask blank according to any one of claims 1 to 3, wherein the upper surface region consists of a material comprising Co alone, Ni alone, $CoTa_3$, CoTa, Co_3Ta, $NiTa_3$, NiTa, or NiTa.

~~4~~5. The reflective mask blank according to any one of claims 1 to ~~3~~4, wherein the absorber film is a layered film including a lower layer including the lower surface region and an upper layer including the upper surface region, and when a concentration (atomic %) of the high absorption coefficient element that is included in a material of the lower layer is $C1_{lower}$ and a concentration (atomic %) of the high absorption coefficient element that is included in a material of the upper layer is $C1_{upper}$, the following formula holds:

$$C1_{upper} > C1_{lower} \geq 0 \cdots \text{(Formula 1)}$$

~~5~~6. The reflective mask blank according to claim ~~4~~5, wherein when a concentration (atomic %) of the element that is included in the material of the lower layer and increases the dry etching rate is $C2_{lower}$, and a concentration (atomic %) of the element that is included in the material of the upper layer and increases the dry etching rate, is $C2_{upper}$, the following formula holds:

$$C2_{lower} > C2_{upper} \geq 0 \cdots \text{(Formula 2)}$$

~~6~~7. The reflective mask blank according to claim ~~4~~5 or ~~5~~6, wherein the material of the upper layer includes cobalt (Co) and tantalum (Ta), and the material of the lower layer includes tantalum (Ta).

~~7~~8. The reflective mask blank according to claim ~~4~~5 or ~~5~~6, wherein the material of the upper layer includes nickel (Ni) and tantalum (Ta), and the material of the lower layer includes tantalum (Ta).

~~8~~9. The reflective mask blank according to any one of claims ~~4~~5 to ~~7~~8, wherein the upper layer includes a material that is etchable by a dry etching gas including a first chlorine-based gas, and the lower layer includes a material that is etchable by a dry etching gas including a second chlorine-based gas different from the first chlorine-based gas.

~~9~~10. The reflective mask blank according to any one of claims 1 to ~~8~~9, wherein a protective film is provided between the multilayer reflective film and the absorber film.

~~10~~11. The reflective mask blank according to claim ~~9~~10, wherein an etching stopper film is provided between the protective film and the absorber film, and the etching stopper film includes a material including chromium (Cr) or a material including silicon (Si).

~~11~~12. The reflective mask blank according to any one of claims 1 to ~~10~~11, wherein an etching mask film is provided on the absorber film, and the etching mask film includes a material including chromium (Cr) or a material including silicon (Si).

~~12~~13. A reflective mask having an absorber pattern that is the absorber film with patterned in the reflective mask blank according to any one of claims 1 to ~~11~~12 is patterned.

~~13~~14. A method of manufacturing a reflective mask, the method comprising: forming an absorber pattern by patterning the absorber film of the reflective mask blank according to any one of claims 1 to ~~11~~12 by dry etching using a chlorine-based gas.

~~14~~15. A method of manufacturing a reflective mask, the method comprising: forming an absorber pattern by patterning the absorber film of the reflective mask

blank according to any one of claims 1 to ~~11~~ 12 by dry etching using a first chlorine-based gas and a second chlorine-based gas different from the first chlorine-based gas.

~~15~~16. A method of manufacturing a semiconductor device, the method comprising: a step of setting the reflective mask according to claim ~~12~~ 13 in an exposure apparatus having an exposure light source that emits EUV light and transferring a transfer pattern to a resist film formed on a transfer-receiving substrate.