CLAIMS

1. A method for manufacturing a photomask blank having at least functional film on a transparent substrate, wherein

the functional film is made of a chromium-containing material including a chromium element and a metallic element that is capable of bringing a mixture of the metallic element and the chromium into a liquid phase at a temperature of 400°C or lower; and,

in a step of forming the functional film,

a chromium target (target A) and a target (target B) mainly containing at least one kind of the metallic element are simultaneously sputtered (co-sputtered).

2. The method for manufacturing a photomask blank according to claim 1, wherein,

in the step of forming the functional film, at least one of the target A and the target B is used more than one.

3. The method for manufacturing a photomask blank according to claim 1 or 2, wherein

an expression: $S_B < S_A$ is given when the total area of the target A is S_A and the total area of the target B is S_B.

4. The method for manufacturing a photomask blank according to claim 3, wherein

a ratio (S_B/S_A) between the total surface area S_A and the total surface area S_B is set to 0.7 or lower.

5. The method for manufacturing a photomask blank according to claim 4, wherein,

a ratio (S_B/S_A) between the total surface area S_A and the total surface area S_B is set to 0.01 or higher.

6. The method for manufacturing a photomask blank according to any one of claims 1 to 5, wherein

the functional film includes at least one of a light-shielding film, an anti-reflection film, an etching mask film, and an etching stopper film.

7. The method for manufacturing a photomask blank according to any one of claims 1 to 5, wherein,

the functional film includes any of a light-shielding film or an anti-reflection film.

8. The method for manufacturing a photomask blank according to any one of claims 1 to 5, wherein,

the functional film is a light-shielding film.

9. A photomask blank manufactured by the method according to any one of claims 1 to 5, wherein

a content ratio ([Me]/[Cr]) between a chromium element (Cr) and a metallic element (Me) capable of bringing a mixture of the metallic element and the chromium into a liquid phase at a temperature of 400°C or lower is 0.7 or lower in terms of atomic ratio.

10. A photomask produced by forming a pattern on the photomask blank according to claim 9.

11. A method for transferring a pattern, wherein

the pattern is transferred to a photoresist by carrying out exposure using the photomask according to claim 10.

12. A sputtering device comprising:

a chromium target (target A); and a target (target B) mainly containing a metallic element that is capable of bringing a mixture of the metallic element and the chromium into a liquid phase at a temperature of 400°C or lower, the target A and the target B being provided as separate film-forming targets, wherein

electric power is independently supplied to the film-forming targets; and

the surface area S_B of the target B is designed smaller than the surface area S_A of the target A.

13. The sputtering device according to claim 12, wherein at least one of the target A and the target B is arranged more than one.

14. The sputtering device according to claim 12 or 13, wherein

a ratio (S_B/S_A) between the total surface area S_B of the target B and the total surface area S_A of the target A is 0.7 or lower and 0.01 or higher.

15. The sputtering device according to any one of claims 12 to 14, wherein

the sputtering device includes a holder configured to be in-plane rotatable; and

a sputtering substrate for film formation is held on the holder while a film-forming surface of the sputtering substrate is kept facing the surface of the target.

CLAIMS

[Claim 1]

A method for manufacturing a photomask blank having at least functional film on a transparent substrate, wherein

the functional film is made of a chromium-containing material including a chromium element and a tin (Sn) element as a metallic element that is capable of bringing a mixture of the metallic element and the chromium into a liquid phase at a temperature of 400°C or lower; and,

in a step of forming the functional film,

a chromium target (target A) and a target (target B) mainly containing the tin (Sn) are simultaneously sputtered (co-sputtered), wherein

the functional film is any one of a light-shielding film, an anti-reflection film, an etching mask film, an etching stopper film, and a layer stacking any of a plurality of the films.

[Claim 2]

The method for manufacturing a photomask blank according to claim 1, wherein, in the step of forming the functional film, at least one of the target A and the target B is used more than one.

[Claim 3]

The method for manufacturing a photomask blank according to claim 1 or 2, wherein an expression: $S_B < S_A$ is given when the total area of the target A is S_A and the total area of the target B is S_B.

[Claim 4]

The method for manufacturing a photomask blank according to claim 3, wherein

a ratio (S_B/S_A) between the total surface area S_A and the total surface area S_B is set to 0.7 or lower.

[Claim 5]

The method for manufacturing a photomask blank according to claim 4, wherein,

a ratio (S_B/S_A) between the total surface area S_A, and the total surface area S_B is set to 0.01 or higher.