CLAIMS

1. A mask blank having a structure in which an etching stopper film and a pattern-forming thin film are laminated on a transparent substrate in this order, wherein:

the pattern-forming thin film is made of a material containing one or more elements selected from silicon and tantalum;

a thickness of the pattern-forming thin film is 30 nm or more;

the etching stopper film is made of a material containing chromium, oxygen, and carbon;

a thickness of the etching stopper film is 15 nm or less;

the etching stopper film has a chromium content of 50 atomic% or more, the etching stopper film has a maximum peak of N1s narrow spectrum, obtained by analysis of X-ray photoelectron spectroscopy, which is not higher than a lower detection limit, and

the etching stopper film has a maximum peak of Cr2p narrow spectrum, obtained by analysis of X-ray photoelectron spectroscopy, at a binding energy of 574 eV or less.

2. The mask blank according to claim 1, wherein a ratio of a carbon content [atomic%] divided by a total content [atomic%] of chromium, carbon, and oxygen in the etching stopper film is 0.1 or more.

3. The mask blank according to claim 1 or 2, wherein the etching stopper film has a maximum peak of Si2p narrow spectrum, obtained by analysis of X-ray photoelectron spectroscopy, which is not higher than a lower detection limit.

4. The mask blank according to any one of claims 1 to 3, wherein the etching stopper film has a maximum peak of C1s narrow spectrum, obtained by analysis of X-ray photoelectron spectroscopy, at a binding energy of 282 eV or more and 238eV or less.

5. The mask blank according to any one of claims 1 to 4, wherein the etching stopper film has a chromium content of 80 atomic% or less.

6. The mask blank according to any one of claims 1 to 5, wherein the etching stopper film has a carbon content of 10 atomic% or more and 20 atomic% or less.

7. The mask blank according to any one of claims 1 to 6, wherein the etching stopper film has an oxygen content of 10 atomic% or more and 35 atomic% or less.

8. The mask blank according to any one of claims 1 to 7, wherein a total content of chromium, oxygen, and carbon in the etching stopper film is 95 atomic% or more.

9. The mask blank according to any one of claims 1 to 8, wherein the etching stopper film has a difference in content of each constituent element in a thickness direction that is less than 10 atomic%.

10. The mask blank according to any one of claims 1 to 9, comprising a hard mask film formed on the pattern-forming thin film and made of a material containing chromium.

11. The mask blank according to claim 10, comprising a phase shift film formed between the transparent substrate and the etching stopper film and made of a material containing silicon.

12. A method for manufacturing a transfer mask using the mask blank according to claim 10, comprising:

the step of forming a transfer pattern on the hard mask film through dry etching using, as a mask, a resist film formed on the hard mask film and having a transfer pattern and using a mixed gas of a chlorine-based gas and an oxygen gas;

the step of forming a transfer pattern on the pattern-forming thin film through dry etching using, as a mask, the hard mask film provided with the transfer pattern and using a fluorine-based gas; and

the step of forming a transfer pattern on the etching stopper film and removing the hard mask film through dry etching using, as a mask, the pattern-forming thin film provided with the transfer pattern and using a mixed gas of a chlorine-based gas and an oxygen gas.

13. A method for manufacturing a transfer mask using the mask blank according to claim 11, comprising:

the step of forming a transfer pattern on the hard mask film through dry etching using, as a mask, a resist film formed on the hard mask film and having a transfer pattern and using a mixed gas of a chlorine-based gas and an oxygen gas;

the step of forming a transfer pattern on the pattern-forming thin film through dry etching using, as a mask, the hard mask film provided with the transfer pattern and using a fluorine-based gas;

the step of forming, on the hard mask film, a resist film having a light shielding pattern;

the step of forming, through dry etching using a mixed gas of a chlorine-based gas and an oxygen gas, a transfer pattern on the etching stopper film by using, as a mask, the pattern-forming thin film provided with the transfer pattern and simultaneously forming a light shielding pattern on the hard mask film by using, as a mask, the resist film having the light shielding pattern;

the step of forming, through dry etching using a fluorine-based gas, a transfer pattern on the phase shift film by using, as a mask, the etching stopper film provided with the transfer pattern and simultaneously forming a light shielding pattern on the pattern-forming thin film by using, as a mask, the hard mask film having the light shielding pattern; and

the step of forming a light shielding pattern on the etching stopper film and removing the hard mask film through dry etching using, as a mask, the pattern-forming thin film provided with the light shielding pattern and using a mixed gas of a chlorine-based gas and an oxygen gas.

14. A method for manufacturing a semiconductor device, comprising the step of exposure-transferring a transfer pattern onto a resist film on a semiconductor substrate by using a transfer mask manufactured by the method for manufacturing a transfer mask according to claim 12 or 13.