WHAT IS CLAIMED IS:

1. A mask blank having a structure in which a pattern-forming thin film and a hard mask film are formed as layers on a substrate in this order;

wherein the hard mask film is made of a material containing silicon and oxygen;

wherein an Si2p narrow spectrum, obtained by analyzing the hard mask film by X-ray photoelectron spectroscopy, has a maximum peak at a binding energy of at least 103 eV;

wherein an N1s narrow spectrum, obtained by analyzing the hard mask film by X-ray photoelectron spectroscopy, has a maximum peak below a detection lower limit value;

wherein, in the hard mask film, a content ratio (atomic%) of silicon and oxygen is Si : O = 1 : less than 2; and

wherein a difference is at most 0.2 eV between a binding energy at which a maximum peak is present in an Si2p narrow spectrum obtained by analyzing a surface of the hard mask film by X-ray photoelectron spectroscopy and a binding energy at which a maximum peak is present in an Si2p narrow spectrum obtained by analyzing an inside of the hard mask film by X-ray photoelectron spectroscopy and / or a difference is at most 0.1 eV between a binding energy at which a maximum peak is present in an O1s narrow spectrum obtained by analyzing a surface of the hard mask film by X-ray photoelectron spectroscopy and a binding energy at which a maximum peak is present in an O1s narrow spectrum obtained by analyzing an inside of the hard mask film by X-ray photoelectron spectroscopy.

2. The mask blank according to claim 1, wherein an O1s narrow spectrum, obtained by analyzing the hard mask film by X-ray photoelectron spectroscopy, has a maximum peak at a binding energy of at least 532 eV.

3. The mask blank according to claim 1 or 2, wherein an O1s narrow

spectrum, obtained by analyzing the hard mask film by X-ray photoelectron spectroscopy, has a maximum peak at a binding energy of less than 533 eV.

4. The mask blank according to any one of claims 1 to 3, wherein the Si2p narrow spectrum, obtained by analyzing the hard mask film by X-ray photoelectron spectroscopy, has no peak at a binding energy in a range of at least 97 eV and at most 100 eV.

5. The mask blank according to any one of claims 1 to 4, wherein the hard mask film has an oxygen content of at least 60 atomic%.

6. The mask blank according to any one of claims 1 to 5, wherein the hard mask film is formed of a material containing silicon, oxygen, and at least one element selected from non-metal elements except nitrogen and metalloid elements.

7. The mask blank according to any one of claims 1 to 5, wherein the hard mask film is formed of a material consisting of silicon and oxygen.

8. The mask blank according to any one of claims 1 to 7, wherein the pattern-forming thin film is made of a material containing at least one element selected from chromium, tantalum, and nickel.

9. The mask blank according to any one of claims 1 to 8, wherein the pattern-forming thin film is a light-shielding film.

10. The mask blank according to claim 9, wherein a phase shift film is formed between the substrate and the light-shielding film.

11. The mask blank according to any one of claims 1 to 8, wherein the pattern-forming thin film is an absorber film.

12. A method for manufacturing a transfer mask by using the mask blank according to any one of claims 1 to 11, comprising the steps of:

forming a transfer pattern on the hard mask film by dry etching using a fluorine-based gas and using, as a mask, a resist film formed on the hard mask film and having the transfer pattern; and

forming the transfer pattern on the pattern-forming thin film by dry etching using a chlorine-containing gas and using, as a mask, the hard mask film with the transfer pattern formed thereon.

13. The method according to claim 12, wherein the dry etching using the chlorine-containing gas is dry etching which is carried out by using an oxygen-containing chlorine-based gas with an increased ratio of a chlorine-based gas and under a condition where a high bias voltage is applied.

14. The method according to claim 12, wherein the dry etching using the chlorine-containing gas is dry etching which is carried out by using an oxygen-free chlorine-based gas and under a condition where a high bias voltage is applied.

15. A method for manufacturing a semiconductor device, comprising a step of using the transfer mask manufactured by the method according to any one of claims 12 to 14 and transferring by exposure the transfer pattern on a resist film on a substrate to be provided with a semiconductor device.