CLAIMS

1. A photomask blank comprising:

a first film containing chromium and which is not substantially etched by dry etching using fluorine and which is etchable by dry etching using oxygen-containing chlorine, the first film being a metal compound film mainly comprising chromium oxide, chromium nitride, or chromium oxynitride, or a metal film or an alloy film mainly comprising chromium;

a second film, stacked on the first film, containing no chromium and which is etchable by dry etching using fluorine and is etchable by dry etching using oxygen-containing chlorine, the second film being a silicon oxide film, a silicon nitride film, or a silicon oxynitride film, and the second film containing a transition metal selected from molybdenum, tantalum, tungsten, zirconium, hafnium, vanadium, and niobium, wherein an atomic configuration of the second film is such that the transition metal accounts for at least 10 at % of a sum of the transition metal and silicon;

at least one of a light blocking film, an antireflective film, a hard mask film, a phase-shift film, and a transparent substrate, each of which is not substantially etched by the dry etching using oxygen-containing chlorine and each of which is etchable by the dry etching using fluorine, provided under the first film; and

a chemical amplification resist film for electron beam lithography, which is at least 50 nm and at most 350 nm in film thickness, formed on and in contact with the second film.

2. The photomask blank according to claim 1, wherein the first film is at least one of

a light blocking film having a first film thickness of 30 nm to 120 nm,

an antireflective film having a first film thickness of 30 nm to 120 nm, and

a hard mask film having a second film thickness of 2 nm to 30 nm.

3. The photomask blank according to claim 1, wherein the second film is at least 0.5 nm and at most 10 nm in film thickness.

4. A method for manufacturing a photomask, comprising: providing a photomask blank that comprises:

a first film containing chromium and which is not substantially etched by dry etching using fluorine and which is etchable by dry etching using oxygen-containing chlorine, the first film being a metal compound film mainly comprising chromium oxide, chromium nitride, or chromium oxynitride, or a metal film or an alloy film mainly comprising chromium, and

a second film, stacked on the first film, containing no chromium and which is etchable by dry etching using fluorine and etchable by dry etching using oxygen-containing chlorine, the second film being a silicon oxide film, a silicon nitride film, or a silicon oxynitride film, and the second film containing a transition metal selected from molybdenum, tantalum, tungsten, zirconium, hafnium, vanadium, and niobium, wherein an atomic configuration of the second film is such that the transition metal accounts for at least 10 at % of a sum of the transition metal and silicon;

forming a resist pattern on the second film; and

using the resist pattern as an etching mask to etch the first film and the second film by the dry etching using oxygen-containing chlorine,

wherein at least one of a light blocking film, an antireflective film, a hard mask film, a phase-shift film, and a transparent substrate, each of which is not substantially etched by the dry etching using oxygen-containing chlorine and each of which is etchable by the dry etching using fluorine, is provided under the first film, and

a chemical amplification resist film for electron beam lithography, which is at least 50 nm and at most 350 nm in film thickness, is formed on and in contact with the second film.

5. The method for manufacturing a photomask according to claim 4, wherein the first film is at least one of

a light blocking film having a first film thickness of 30 nm to 120 nm,

an antireflective film having a first film thickness of 30 nm to 120 nm, and

a hard mask film having a second film thickness of 2 nm to 30 nm.

6. The method for manufacturing a photomask according to claim 4, wherein the second film is at least 0.5 nm and at most 10 nm in film thickness.