CLAIMS

WHAT IS CLAIMED IS:

1. A method of manufacturing a blank mask, comprising:

providing a light transmissive substrate;

disposing a light-blocking layer on the light transmissive substrate, the light-blocking layer comprising a transition metal and either one or both of oxygen and nitrogen, wherein the transition metal comprises Cr and Fe, and

measuring the average value of the grain sizes of the surface of the light-blocking layer through a secondary electron microscope (SEM);

wherein disposing the light-blocking layer comprises

applying a sputtering target comprising 0.0001 to 0.035 parts by weight of Fe based on a total of 100 parts by weight of the transition metal, and

controlling an average value of grain sizes of a surface of the light-blocking layer to be in the range from 14 nm to 24 nm,

wherein the SEM is operated at a measurement magnification of 150k, a voltage of 5.0 kV, and a working distance (WD) (a distance between a lens and a sample) of 4 mm, and

wherein the average value of the grain sizes of the surface of the light-blocking layer is determined from an SEM image using an intercept method disclosed in ASTM E112-96e1.

2. The method of claim 1, wherein disposing the light-blocking layer on the light transmissive substrate comprises controlling a number of grains on the surface of the light-blocking layer to be 20 or more and 55 or less per 0.01 μm^2.

3. The method of claim 1, wherein disposing the light-blocking layer comprises

disposing a first light-blocking layer on the light transmissive substrate and a second light-blocking layer on the first light-blocking layer, and

controlling an etching speed of the second light-blocking layer when etched with argon gas to be 0.3 Å/s or more and 0.5 Å/s or less.

4. The method of claim 1, wherein

disposing the light-blocking layer comprises disposing a first light-blocking layer on the light transmissive substrate and a second light-blocking layer on the first light-blocking layer, and

controlling an etching speed of the first light-blocking layer when etched with argon gas to be 0.56 Å/s or more.

5. The method of claim 1, further comprising controlling an etching speed of the light-blocking layer when etched with a chlorine-based gas to be 1.5 Å/s or more.

6. The method of claim 1, wherein the transition metal further includes any one or more among Ta, Ti, and Hf.

7. The method of claim 1, wherein

disposing the light-blocking layer comprises disposing a first light-blocking layer on the light transmissive substrate and a second light-blocking layer on the first light-blocking layer,

wherein the second light-blocking layer includes 40 at% or more and 70 at% or less transition metal.

8. A method of manufacturing a photomask comprising:

providing a light transmissive substrate;

disposing a light-blocking pattern layer on the light transmissive substrate, the light-blocking pattern layer comprising a transition metal and either one or both of oxygen and nitrogen, wherein the transition metal comprises Cr and Fe, and

measuring the average value of the grain sizes of the surface of the light-blocking pattern layer through a secondary electron microscope (SEM);

wherein disposing the light-blocking layer comprises

applying a sputtering target comprising 0.0001 to 0.035 parts by weight of Fe based on a total of 100 parts by weight of the transition metal, and

controlling an average value of grain sizes of a surface of the light-blocking pattern layer to be in the range from 14 nm to 24 nm,

wherein the SEM is operated at a measurement magnification of 150k, a voltage of 5.0 kV, and a working distance (WD) (a distance between a lens and a sample) of 4 mm, and

wherein the average value of the grain sizes of the surface of the light-blocking pattern layer is determined from an SEM image using an intercept method disclosed in ASTM E112-96e1.

9. A method of manufacturing a semiconductor device, comprising:

preparing a light source, a photomask, and a semiconductor wafer, onto which a resist film has been applied;

selectively transmitting a light incident from the light source through the photomask onto the semiconductor wafer; and

developing a pattern on the semiconductor wafer,

wherein preparing the photomask comprises

providing a light transmissive substrate,

disposing a light-blocking pattern layer on the light transmissive substrate, and

measuring the average value of the grain sizes of the surface of the light-blocking pattern layer through a secondary electron microscope (SEM),

wherein the light-blocking pattern layer includes a transition metal and either one or both of oxygen and nitrogen, wherein the transition metal comprises Cr and Fe, wherein disposing the light-blocking layer comprises

applying a sputtering target comprising 0.0001 to 0.035 parts by weight of Fe based on a total of 100 parts by weight of the transition metal, and

controlling an average value of grain sizes of a surface of the light-blocking pattern layer to be in the range from 14 nm to 24 nm,

wherein the SEM is operated at a measurement magnification of 150k, a voltage of 5.0 kV, and a working distance (WD) (a distance between a lens and a sample) of 4 mm, and

wherein the average value of the grain sizes of the surface of the light-blocking pattern layer is determined from an SEM image using an intercept method disclosed in ASTM E112-96e1.

10. The method of claim 9, wherein disposing the light-blocking layer comprises disposing a plurality of light-blocking layers,

wherein disposing the plurality of light-blocking layers comprises controlling an etching speed of a topmost light-blocking layer of the plurality of light-blocking layers etched with argon gas to be 0.3 Å/s or more and 0.5 Å/s or less.

11. The method of claim 9, wherein disposing the light-blocking layer comprises disposing a plurality of light-blocking layers,

wherein disposing the plurality of light-blocking layers comprises controlling an etching speed of an intermediate light-blocking layer of the plurality of light-blocking layers etched with argon gas to be 0.56 Å/s or more.