CLAIMS

1. A substrate with multilayer reflective film provided with a multilayer reflective film for reflecting exposure light, the multilayer reflective film comprising a multilayer film obtained by alternately laminating low refractive index layers and high refractive index layers on a substrate,

wherein the multilayer reflective film contains krypton (Kr),

wherein the low refractive index layers comprise a metal selected from molybdenum (Mo), ruthenium (Ru), rhodium (Rh) and platinum (Pt), or an alloy thereof,

wherein the high refractive index layers comprise silicon (Si) and have an amorphous structure, and

wherein the krypton (Kr) content of the multilayer reflective film is not less than 1 at% and not more than 3 at%.

2. The substrate with multilayer reflective film according to claim 1, wherein the krypton (Kr) content of the multilayer reflective film is not less than 1 at% and not more than 1.5 at%.

3. The substrate with multilayer reflective film according to claim 1 or 2, wherein the ratio of Kr content to Si content is not more than 0.06.

4. The substrate with multilayer reflective film according to any of claims 1 to 3, wherein

the low refractive index layers comprise molybdenum (Mo) and the high refractive index layers comprise silicon (Si), and

the krypton (Kr) content of the low refractive index layers is relatively low in comparison with the high refractive index layers.

5. The substrate with multilayer reflective film according to any of claims 1 to 4, comprising a protective film on the multilayer reflective film.

6. A reflective mask blank comprising an absorber film on the multilayer reflective film of the substrate with multilayer reflective film according to any of claims 1 to 4 or on the protective film of the substrate with multilayer reflective film according to claim 5.

7. A reflective mask comprising an absorber pattern, obtained by patterning the absorber film of the reflective mask blank according to claim 6, on the multilayer reflective film.

8. A method of manufacturing a substrate with multilayer reflective film provided with a multilayer reflective film for reflecting exposure light, the multilayer reflective film comprising a multilayer film obtained by alternately laminating low refractive index layers and high refractive index layers on a substrate, and

the method comprising forming the multilayer reflective film containing krypton (Kr),

wherein the low refractive index layers comprise a metal selected from molybdenum (Mo), ruthenium (Ru), rhodium (Rh) and platinum (Pt), or an alloy thereof,

wherein the high refractive index layers comprise silicon (Si) and have an amorphous structure, and

wherein the krypton (Kr) content of the multilayer reflective film is not less than 1 at% and not more than 3 at%.

9. The method of manufacturing the substrate with multilayer reflective film according to claim 8, comprising forming a protective film on the multilayer reflective film.

10. The method of manufacturing the substrate with multilayer reflective film according to claim 8 or 9, comprising carrying out heat treatment at 210°C to 300°C on the substrate with multilayer reflective film in the state in which the multilayer reflective film has been formed, or in the state in which the protective film has been formed on the multilayer reflective film.

11. The method of manufacturing the substrate with multilayer reflective film according to any of claims 8 to 10, wherein

the low refractive index layers comprise molybdenum (Mo) and the high refractive index layers comprise silicon (Si), and

the krypton (Kr) content of the low refractive index layers is relatively low in comparison with the high refractive index layers.

12. The method of manufacturing the substrate with multilayer reflective film according to any of claims 8 to 11, wherein the multilayer reflective film is deposited by ion beam sputtering.

13. A method of manufacturing a reflective mask blank comprising forming an absorber film on the multilayer reflective film or on the protective film manufactured by the method of manufacturing the substrate with multilayer reflective film according to any of claims 8 to 12.

14. A method of manufacturing a reflective mask comprising forming an absorber pattern, obtained by patterning the absorber film manufactured by the method of manufacturing a reflective mask blank according to claim 13.

15. A method of manufacturing a semiconductor device comprising a step for forming a transfer pattern on a transferred substrate by carrying out a lithography process with an exposure device using the reflective mask according to claim 7.