[0074]

<Comparative Example 2>

[Manufacture of Mask Blank]

A mask blank of Comparative Example 2 was manufactured by the same process as Example 1, except for the hard mask film 4. A hard mask film 4 of Comparative Example 2 had a single layer structure including tantalum, boron, and oxygen, with a thickness of 9.5nm. Concretely, the hard mask film 4 was formed by placing a transparent substrate 1 having a phase shift film 2 and an absorber film 3 formed thereon in a single-wafer DC sputtering apparatus, and by DC sputtering using a mixed target of tantalum (Ta) and boron (B) (Ta:B=4:1 atomic ratio) with argon (Ar) gas and oxygen (O) gas as sputtering gas.

[0075]

On each of another plurality of transparent substrates 1, a single layer hard mask film was formed under the same film forming conditions as Comparative Example 2, and a plurality of substrates with a hard mask film was manufactured. The average value of each 3σ of the resist patterns on the three substrates each having a hard mask film was calculated through the same procedure as Example 1. The average value of 3σ of the in-plane CD uniformity was 1.43nm, which was satisfactory. The tendency of CD linearity, which is a correlation of a design line width and a CD value of the resist pattern formed on the substrate with a hard mask film, was examined using the same procedure as Example 1, discovering that the increase width of CD value that varies along with reduction of the design line width was small, which is a good tendency. It was also found that a test pattern with a minute line width can be resolved at high precision. In view of these results, it was found that by applying the configuration of the hard mask film 4 of Comparative Example 2, good properties in pattern resolution, in-plane CD uniformity, and CD linearity can be obtained when a resist pattern was formed on the hard mask film 4.

[0076]

[Manufacture of Phase Shift Mask]

Next, using the mask blank of Comparative Example 2, a phase