[0039]

An inspection was actually made when a SiON film (Si:O:N=34atom%:60atom%:6atom%) was applied to the lower layer 41 and a TaBO film (Ta:B:O=36atom%:8atom%:56atom%) was applied to the upper layer 42 of the hard mask film 4. The etching rate of dry etching with fluorine-based gas was measured for each of the SiON film and the TaBO film. As a result, it was found that the etching rate of the TaBO film upper layer 42 was 2.48 times less than the etching rate of the SiON film lower layer 41. FIG. 3 shows a relationship between a ratio of a thickness of the upper layer 42 (Dup) relative to a total thickness of the hard mask film 4 (Dto) (Dup/Dto ratio) and a ratio of an etching rate of the entire hard mask film 4 (Eto) to an etching rate of a SiON single layer film (Esi) (may hereafter be referred to as Eto/Esi ratio), when the total thickness of the hard mask film 4 is fixed to a certain thickness. The result shows that Dup/Dto ratio of 0.7 or less can achieve 0.5 times or more Eto/Esi ratio. The result further shows that Dup/Dto ratio of 0.5 or less can achieve 0.57 times or more Eto/Esi ratio. Moreover, the result shows that Dup/Dto ratio of 0.3 or less can achieve 0.7 times or more Eto/Esi ratio.

[0040]

The same tendency is seen when another material containing tantalum and oxygen is applied to the lower layer 41 and another material containing silicon and oxygen is applied to the upper layer 42. Incidentally, it is preferable for the hard mask film 4, within the scope of $0.07 \leq Rd \leq 0.92$ where Eto/Esi ratio is Re and Dup/Dto ratio is Rd, to satisfy the following equation (1):

Equation (1)

$$Re \geq 0.4047 \times Rd^4 - 1.264 \times Rd^3 + 1.694 \times Rd^2 - 1.431 \times Rd + 0.9995$$

[0041]

[Resist Film]

In the mask blank 100, a resist film formed of an organic-based material is preferably formed at a film thickness of 100nm or less in contact with a surface of the hard mask film 4. In the case of a fine pattern compatible with the DRAM hp32 nm generation, SRAF (Sub-Resolution Assist Feature) having a line width of 40nm may